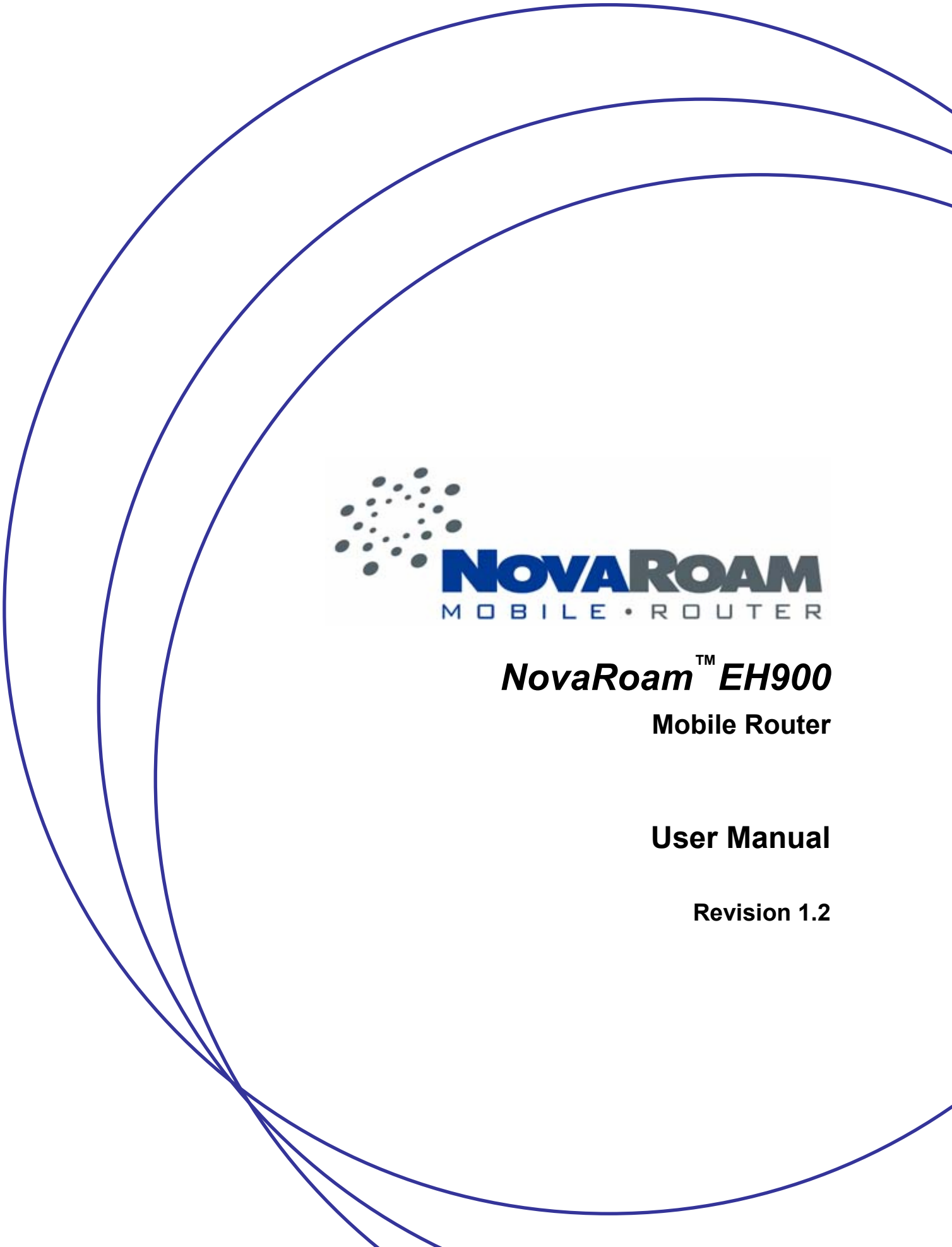

NovaRoam™ EH900

Mobile Router

User Manual

Revision 1.2

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Introduction

About Nova Engineering

Nova Engineering, a 100% employee owned digital and wireless communication systems company, designs, develops, and manufactures high speed data processing and transmission equipment. Since 1989, Nova Engineering, Inc. has pioneered a variety of leading edge projects in both the commercial and government sectors.

Designs include miniature, low power RF communications equipment, waveform development software, high performance modems, ultra-low phase noise synthesizers, embedded real-time signal processing systems, and communication products development tools.

Nova supports the total development cycle from systems engineering, analysis, and computer simulation to printed circuit board design, prototyping, production, and automated testing.

Visit Nova Engineering's website [http://www.nova-eng.com] or contact us at 513-642-3000.

About this Manual

This manual introduces you to the capabilities, features, and operation of the *NovaRoam*. The manual describes how to install and configure the *NovaRoam* and how to facilitate efficient integration into a fully functional wireless network.

This document also explains how to troubleshoot problems that may arise during installation or operation.

This manual is designed for system managers, device installers, and network managers, and assumes a working knowledge of local area networking and routing functions.

Additional technical support is available either directly from Nova Engineering or partners.

Kit Contents

Each *NovaRoam EH900* Kit includes the following items:

Table 1: *NovaRoam EH900* Stationary Kit Contents

Item	Description	Part Number
NovaRoam EH900	Wireless router	NR-EH900-E2
Wall Plug Power Supply [1]	Power input cable	NR-APW-W15DH
Ethernet Cable	Ethernet crossover cable	NR-ACB-E007R

[1] The EH900 mobile kit contains the identical items with the exception of the power supply. The mobile kit contains a DC Car Power Cable (Part Number NR-APW-M12DH) in place of the wall power supply.

Introducing *NovaRoam EH900*

About *NovaRoam*

NovaRoam is a wireless IP router featuring unique ad hoc (mesh) networking capabilities for mobile and stationary applications. In a typical wireless network, the *NovaRoam* is as transparent as a hardwired router. Configuration of the *NovaRoam* is made simple through use of its embedded browser-based configuration software.

Figure 1: *NovaRoam EH900*

System Requirements

To begin configuring your *NovaRoam*, the following is required:

- An Ethernet connection point (10/100BaseT)
- Power connection
- Computer for configuration

NovaRoam Connections and LEDs

The rear panel of the *NovaRoam* has four connectors, one each for the antenna, power, RS-232 serial port, and Ethernet. The *NovaRoam* Ethernet interface features “auto crossover,” which allows you make Ethernet connections using either straight or crossover Ethernet cables. The *NovaRoam* rear panel is shown in Figure 2.

Figure 2: *NovaRoam EH900* Rear View

Name	Device	Description
Antenna	Connector	Antenna, TNC Connector
12 VDC	Connector	Power Connection, 12 VDC
RS-232	Connector	RS-232 Serial Port
Ethernet	Connector	10BaseT Connection

The front panel of the *NovaRoam* has five LEDs as shown in Figure 3. The Power LED denotes that power has been applied and the firmware is loaded. The Tx LED indicates that a packet is being sent over the wireless interface. The Link LED indicates the quality of the wireless link. This LED glows at four levels of

brightness; each brighter level indicating a better link. If the LED is off, no wireless link is established. The Rx LED indicates that a packet was received successfully over the wireless link. The Ethernet Link/Act LED indicates whether an Ethernet connection is established and if there is any traffic on the link.

Figure 3: *NovaRoam ED900* Front Panel

Name	Device	Description
Power	LED (Red)	Power Applied and firmware loaded
TX	LED (Green)	Active RF Transmit
Link	LED (Yellow)	Active RF Link
RX	LED (Green)	Active RF Receive
Link/Act	LED (Green)	Active Ethernet Link/Activity

Security

NovaRoam uses Frequency Hopping Spread Spectrum (FHSS) technology. While FHSS makes it difficult for a casual interceptor or eavesdropper to gain access to the network data flows, a determined adversary can passively intercept or even actively disrupt your network using other *NovaRoam* transceivers or similar types of FHSS equipment. For this reason, if the value of the information flows is significant, the prudent network designer will implement additional mechanisms to authenticate messages and protect the network content from exploitation. One such mechanism for securing TCP/IP connections is the Secure Socket Layer (SSL) protocol. Other mechanisms and protocols can be implemented depending upon your needs.

Contact Nova Engineering for additional security options.

Table 2: *NovaRoam EH900* Radio Frequency Modes

Mode	Data Rate (kbps)	Modulation Type	Transmitter Power (dBm)	Receiver Sensitivity with FEC (dBm)
1	100	GFSK	+30	-108
2	400	GFSK	+30	-103

The *NovaRoam EH900* operates in the 902-928 MHz frequency band, with 16 user selectable Network IDs.

Installing the *NovaRoam*

Installation Checklist

- Unpack and inspect contents of the Kit.
- Connect an approved antenna to the *NovaRoam*.
- Connect power to the *NovaRoam.*
- Connect a computer and *NovaRoam* via the Ethernet cable.
- Configure the *NovaRoam* using its Browser-based Configuration Webpage. For configuration details, refer to the section titled Configuring the *NovaRoam* in this manual.

Preinstallation Planning

Choosing a Location

If operating in a mobile platform, the *NovaRoam* should be mounted firmly. Also, avoid locating the *NovaRoam* near a heat source or in a damp or dusty location.

CAUTION

For fixed installations, Nova Engineering recommends lightning protection.

General Planning

To install your *NovaRoam*, follow these general steps:

- Plan Network setup
- Plan *NovaRoam* configuration
- Connect antenna
- Connect cables
- Connect power

Network Planning

NovaRoams can be used in a wide variety of network configurations. Therefore, it would be impossible to explain how to plan for each configuration in this manual. Planning your network in advance is recommended. Doing so provides an opportunity to develop an IP addressing scheme that makes the most sense for your particular application. Depending on the type of network, several factors may influence your planning.

- Mobile vs. stationary network
- Point-to-point vs. mesh
- Standalone Network vs. Internet connection

Once the network topology is known, the *NovaRoams* can be configured appropriately.

Refer to Appendix B: Routing Options for an example *NovaRoam* network.

Planning *NovaRoam* Configuration

NovaRoams can operate as a bridge or as a router, with multiple router modes to choose from. The best router mode for any given situation depends on the particular needs of the wireless network. After obtaining details about the wireless network, the appropriate *NovaRoam* operation mode can be determined.

Refer to **Appendix B: Routing Options** for more details about routing modes and operation of the *NovaRoam*.

Configuring the *NovaRoam*

Connecting to the *NovaRoam*

The *NovaRoam* provides web browser-based configuration. The *NovaRoam* can be configured using Internet Explorer 5.5 or later. To configure the *NovaRoam*:

- Open a web browser.
- In the browser's address field, enter the IP address of the *NovaRoam* you want to connect to. The default IP address is 192.168.200.1.
- Click Enter (or the Go button) to connect.

Note: Your computer must have an IP address from the same subnet as the *NovaRoam* to which you are attempting to connect.

Logging into the *NovaRoam*

After you are connected to the *NovaRoam*, the logon page displays.

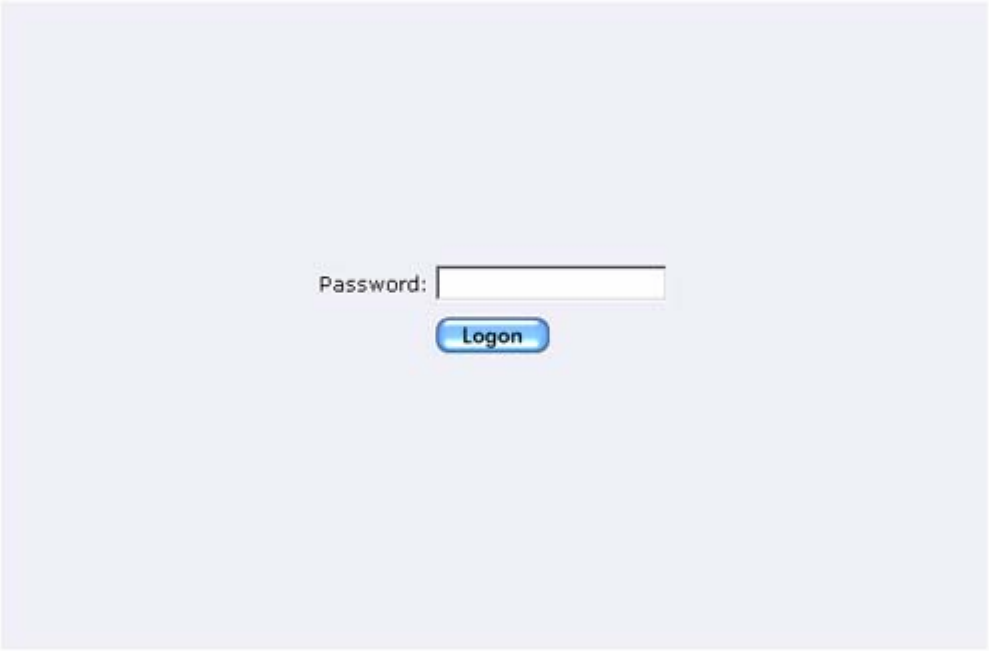

Figure 4: *NovaRoam* Configuration Software Logon Page

- Enter the password. The default password is **novaroam**. It is strongly recommended that you change the default password.
- Click on the Logon button or click on the Enter key. The main configuration page displays.

User Interface Configuration

The *NovaRoam EH900* can be easily configured using its embedded web browser user interface. If you are operating the *NovaRoam* as a router, refer to the Operation Mode: Router section in this manual. If you are operating the *NovaRoam* as a bridge, refer to the

Router Mode

In Router mode, the *NovaRoam* provides a wireless connection between two or more separate IP subnets. Data is then routed between the IP subnets. Route information can be entered manually, or can be handled automatically by AODV, the *NovaRoam's* Mobile Ad hoc Networking (MANET) algorithm.

If operating in Router Mode, there are several router mode options to choose from. To learn more about the Router Mode options, refer to

Bridge Mode

When operating in bridge mode, the *NovaRoam* provides a wireless connection between two or more segments of the same IP subnet. In Bridge mode, all devices have IP addresses from the same subnet. This means that items such as Microsoft Networking work seamlessly over the wireless *NovaRoam* link.

Figure 5 shows an example of a *NovaRoam* network using Bridge mode. In this example, each network device is assigned an IP addresses from the 192.168.1.0 Class C network.

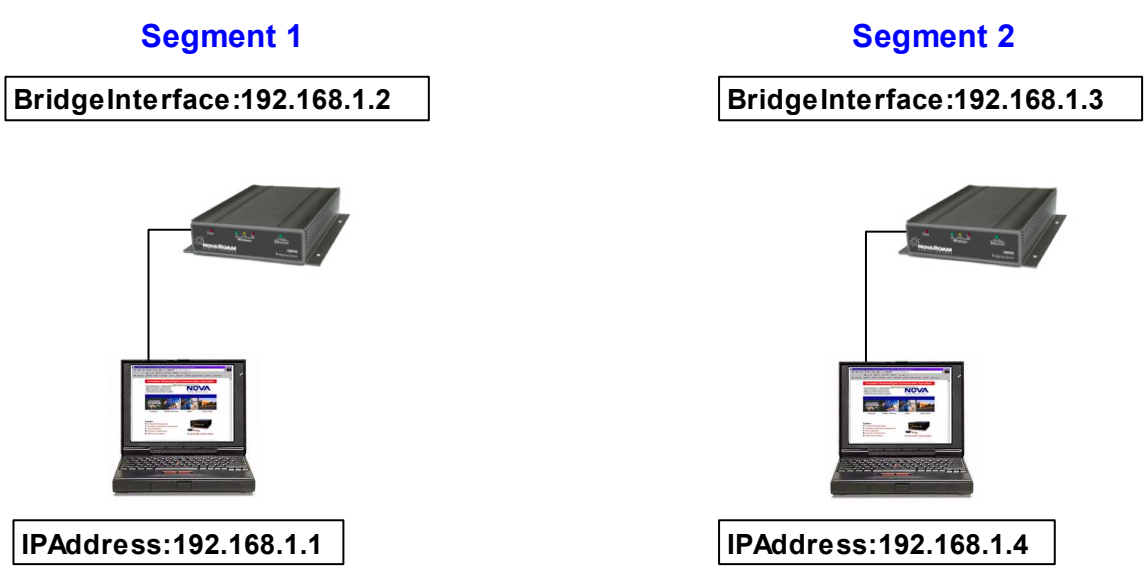

Figure 5: Example of Wireless Network using *NovaRoams* in Bridge Mode

Operation Mode: Router

In Router Mode, the *NovaRoam* routes data packets between different IP subnets. Routes can be entered manually, or created and maintained automatically, through use of the AODV (Ad hoc On-demand Distance Vector) routing algorithm.

Main Configuration Page

The Main configuration page allows you to start the Setup Wizard. Selecting one of the navigation buttons on the left side of the configuration page allows you to configure the various elements of the *NovaRoam*.

Figure 6: *NovaRoam* Configuration Main Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
IP Routing	Opens the IP Routing configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
Setup Wizard	Starts *NovaRoam* Setup Wizard
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be changed to best suit your application.

Using the Setup Wizard

The Setup Wizard simplifies *NovaRoam* configuration by presenting common setup parameters in an easily understandable format. The Setup Wizard can be started by clicking on the Setup Wizard button on the Main configuration page.

Welcome to the NovaRoam Setup Wizard. This wizard will help you quickly configure your NovaRoam.
To continue, press 'Next'.
Next

Figure 7: Setup Wizard Start Page

At the opening screen of the setup wizard, click on the Next button to start configuring the *NovaRoam*.

NOVAROAM
MOBILE • ROUTER
Choose Operation Mode
Choose 'Bridge' if you require the NovaRoam to act as a bridge.
Choose 'Router' if you require the NovaRoam to act as a router.
Router
Back
Next

Figure 8: Setup Wizard Operation Mode Selection Page

The *NovaRoam EH900* can operate as a router or as a bridge. As a **Router**, the *NovaRoam* routes traffic between different IP Subnets. As a **Bridge**, the *NovaRoam* connects different segments of the same IP subnet.

After specifying the Operation Mode, click on the Next button.

Figure 9: Setup Wizard Date Rate Selection Page

The *NovaRoam EH900* can be configured to one of two data rates, 100 kbps or 400 kbps. After specifying the Data Rate, click on the Next button.

Note: All *NovaRoams* that are required to communicate with each other must specify the same data rate.

.

Figure 10: Setup Wizard Network ID Selection Page

Specify the Network ID for the *NovaRoam*. In order for *NovaRoams* to communicate with each other, they must use the same Network ID. Networks can be collocated by using a separate Network ID for each individual network.

After specifying the Network ID, click on the Next button.

Figure 11: Setup Wizard Ethernet IP Address Configuration Page

Specify the IP address and corresponding Subnet Mask for the Ethernet Interface. After specifying the address, click on the Next button.

Figure 12: Setup Wizard Wireless Interface IP Address Configuration Page

Specify the IP address and corresponding Subnet Mask for the Wireless Interface. After specifying the address, click on the Next button.

NOVAROAM
MOBILE • ROUTER
Finish
Congratulations, you have completed the NovaRoam Setup Wizard.
Press the "Finish" button to save changes and return to the main configuration page.
Back
Finish

Figure 13: Setup Wizard Finish Page

Click on the Finish button to complete the setup wizard and return to the main configuration page. If more detailed configuration is required, additional setup options are available from the main configuration page.

Interfaces Configuration Page

The Interfaces Configuration page allows configuration of the Ethernet, Wireless, and Serial interfaces of the *NovaRoam*.

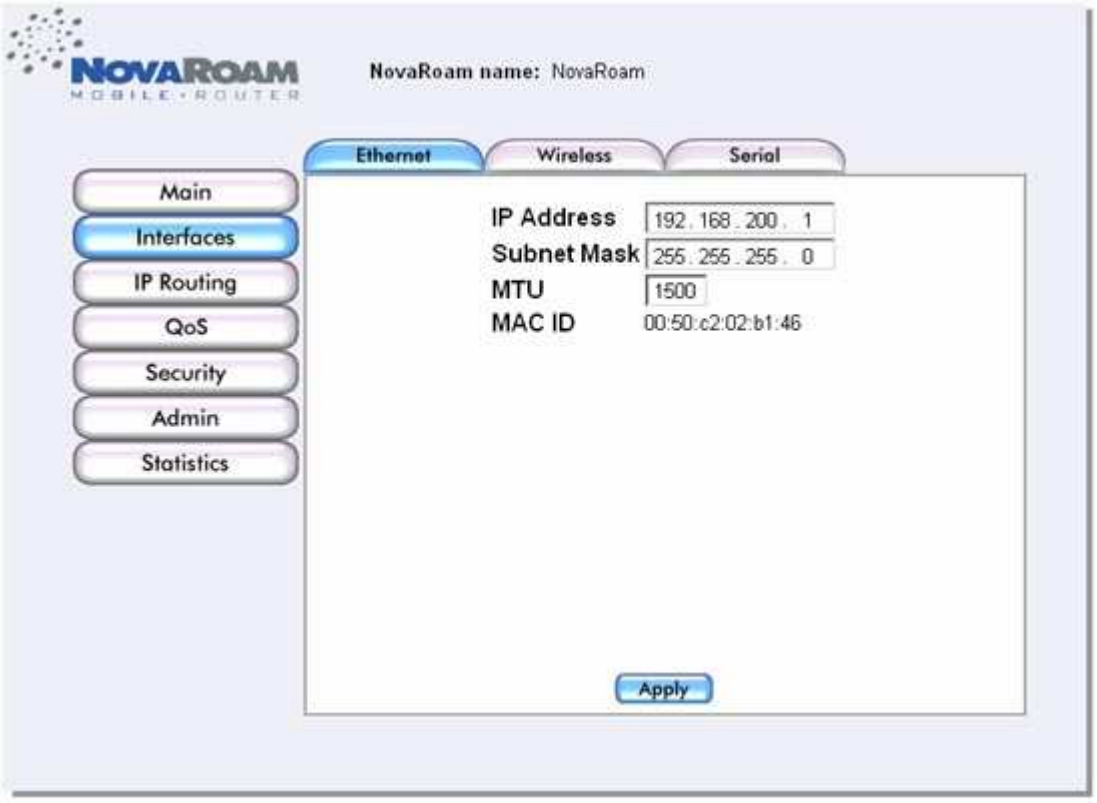

Figure 12: *NovaRoam* Configuration Interfaces Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
IP Routing	Opens the IP Routing configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
Ethernet	Opens the Ethernet Interface Configuration tab
Wireless	Opens the Wireless Interfaces Configuration tab
Serial	Opens the Serial Interface Configuration tab
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be assigned to best suit your application.

Ethernet Tab

The Ethernet tab lets you specify the IP address, subnet mask, and maximum transfer unit (MTU) for the Ethernet network interface.

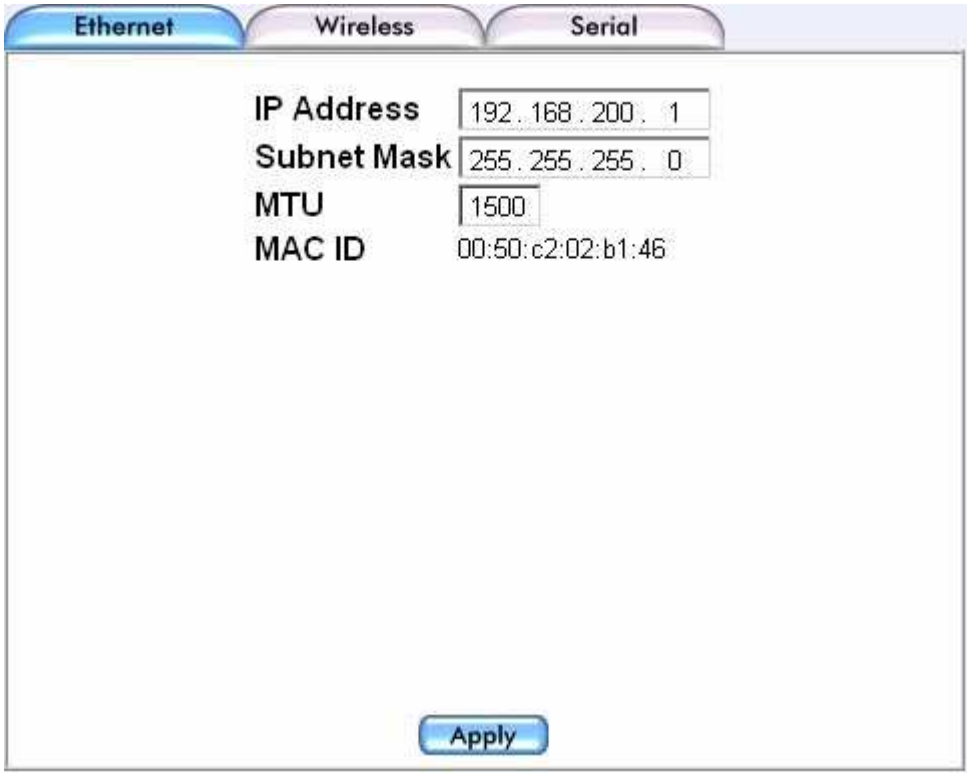

Figure 13: *NovaRoam* Configuration Ethernet Tab

Option Name	What it Does
IP Address	Specifies the IP address of the Ethernet Interface. The default IP address is 192.168.200.1.
Subnet Mask	Specifies the Subnet Mask of the Ethernet Interface
MTU	Maximum Transmit Unit. Specifies the maximum packet size able to be transmitted without being fragmented. This setting is specified in bytes. The default MTU is 1500 bytes. This setting should not require adjustment for most applications.
MAC ID	This *read-only* field specifies the unique Media Access Control (MAC) address of the *NovaRoam* Ethernet interface.
Apply	Applies changes made to the Ethernet Interface configuration page

Wireless Tab

The Wireless tab lets you specify the IP address and subnet mask for the wireless network interface. This is also where the Network ID, data rate, and various wireless options are configured.

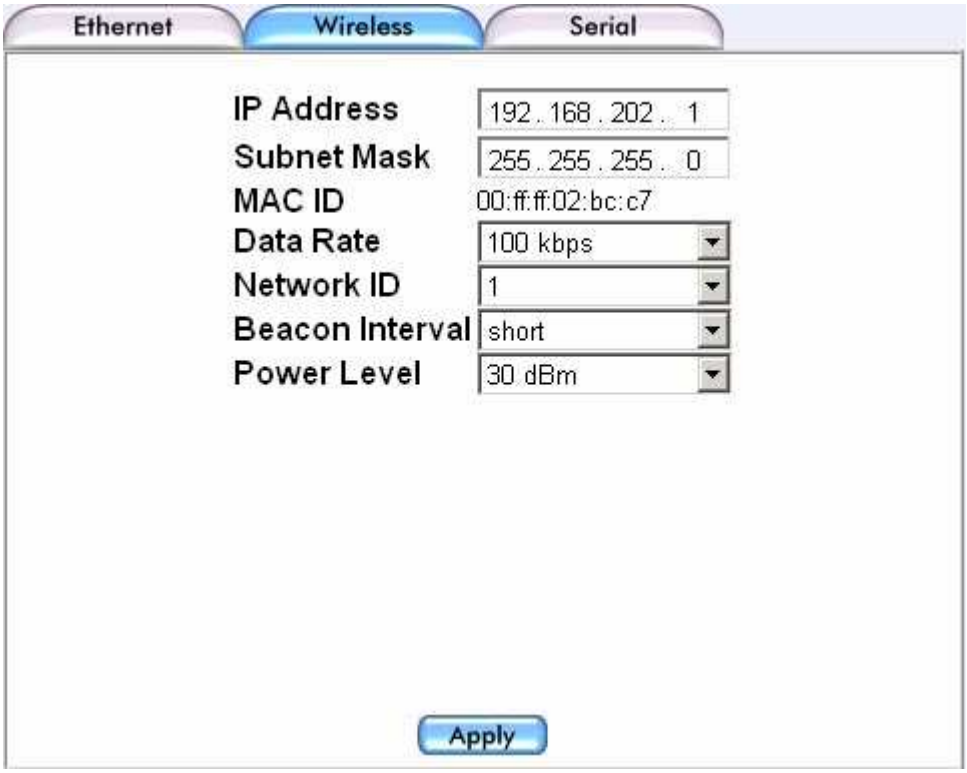

Figure 16: *NovaRoam* Configuration Wireless Tab

Option Name	What it Does
IP Address	Specifies the IP address of the Wireless Interface. The default IP address is 192.168.202.1.
Subnet Mask	Specifies the Subnet Mask of the Wireless Interface.
MAC ID	The *read-only* field specifies the unique Media Access Control (MAC) address of the *NovaRoam* Wireless interface.
Data Rate	Specifies the over-the-air (burst) Data Rate of the *NovaRoam*. Data Rates can be specified as 100 kbps or 400 kbps. The default data rate is 100 kbps.
Network ID	Specifies the Network ID for the *NovaRoam*. In order to communicate with each other, *NovaRoams* must use the same Network ID. Networks can be collocated by using a separate Network ID for each individual network.
Beacon Interval	Specifies the amount of time between beacon transmissions. Options are short and long.
Power Level	Specifies the output power of the *NovaRoam*. Options are 10 dBm, 20 dBm, 25 dBm, and 30 dBm.
Apply	Applies changes made to the Wireless Interface configuration page

Serial Tab

The serial interface of a *NovaRoam* can be used to tunnel raw asynchronous serial data to another *NovaRoam*. The Serial tab allows you to configure the various port settings of the asynchronous serial interface as well as the destination *NovaRoam* address and port number.

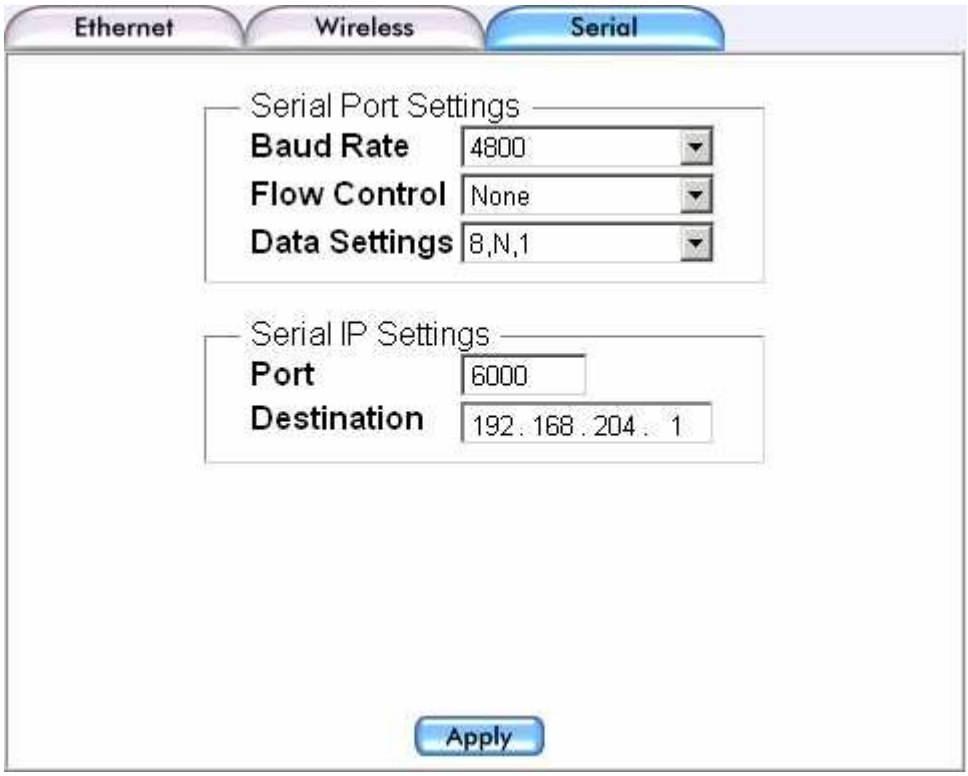

Figure 15: *NovaRoam* Configuration Serial Tab

Option Name	What it Does
Baud Rate	Specifies the baud rate of the serial interface. Available baud rates are 2400, 4800, 9600, 19200, 38400, 57600, and 115200. The default setting is 4800.
Flow Control	Determines whether or not flow control is used on the *NovaRoam* serial interface. Options are None or Hardware. The default setting is None.
Data Settings	Specifies the data settings, specifically data bits, parity, and stop bits. Options are 8,N,1 / 7,E,1 / 7,O,1. The default setting is 8,N,1.
Port	Specifies the port that serial data is sent to and received from. The default port number is 6000. In order for multiple *NovaRoams* to communicate serial data, the same port must be specified on each *NovaRoam.*
Destination	Displays the Destination IP address to which all serial data is sent. The default Destination IP address is 192.168.204.1. Specifying the Wireless Interface of a *NovaRoam* causes serial data to be sent out the serial port of the receiving *NovaRoam*. Specifying the Ethernet Interface of a *NovaRoam* or other device causes serial data to be sent out the Ethernet Interface of the receiving *NovaRoam.*
Apply	Applies changes made to the Serial Interface configuration page

IP Routing Configuration Page

The IP Routing configuration page allows configuration of the IP Routing settings, such as Ad Hoc Routing mode and AODV. Static routes and ARP entries can be viewed or modified on the IP Routing Configuration page.

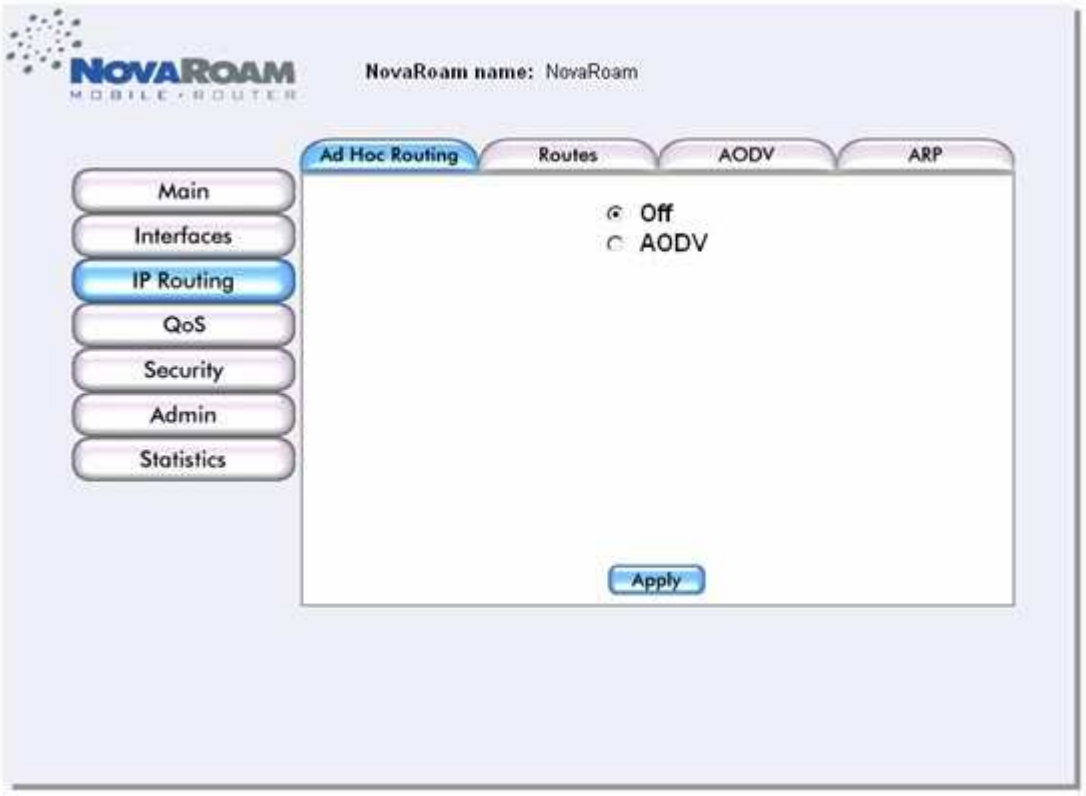

Figure 16: *NovaRoam* Configuration IP Routing Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
IP Routing	Opens the IP Routing configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
Ad Hoc Routing	Opens the Ad Hoc Routing Configuration page
Routes	Opens the Routes Configuration page
AODV	Opens the AODV Configuration page
ARP	Opens the ARP (Address Resolution Protocol) Configuration page
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be assigned to best suit your application.

Ad Hoc Routing Tab

The Ad Hoc Routing tab lets you select the algorithm to use for mobile ad hoc routing. Currently, AODV is the supported algorithm.

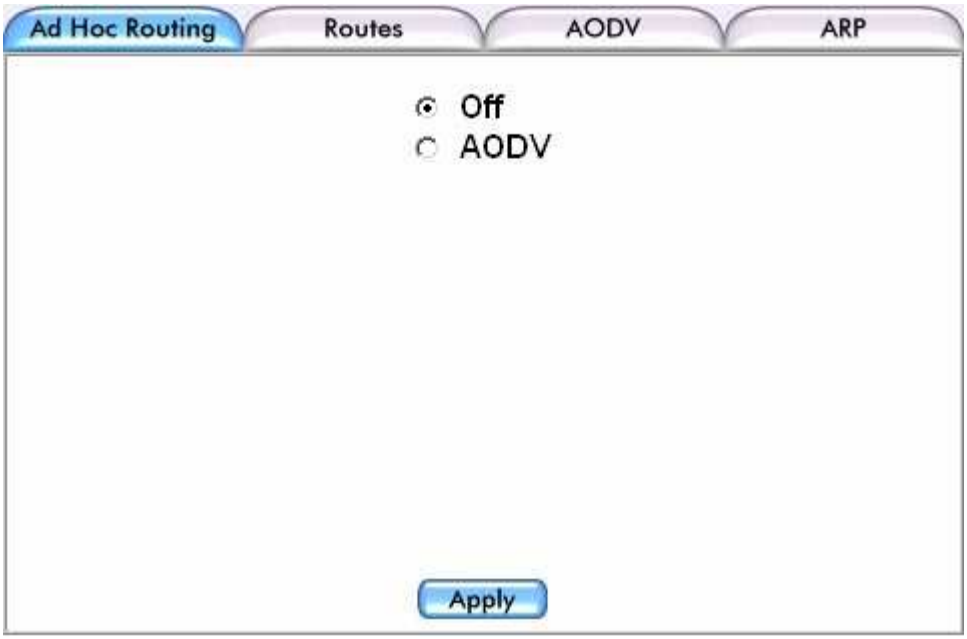

Figure 17: *NovaRoam* Configuration Ad Hoc Routing Tab

Option Name	What it Does
Off	Specifies manual routing mode. In this mode, static routes must be entered manually. Routes can be entered manually from the Routes tab.
AODV	Enables the AODV routing algorithm. AODV allows *NovaRoam* networks to become self-forming and self-healing. Routes are created, maintained, and deleted automatically. Refer to Appendix B for detailed information regarding AODV.
Apply	Applies changes made to the Ad Hoc Routing configuration page

Routes Tab

The Routes tab lets you view current routes in the *NovaRoam* routing table. It also allows you to add and remove static routes.

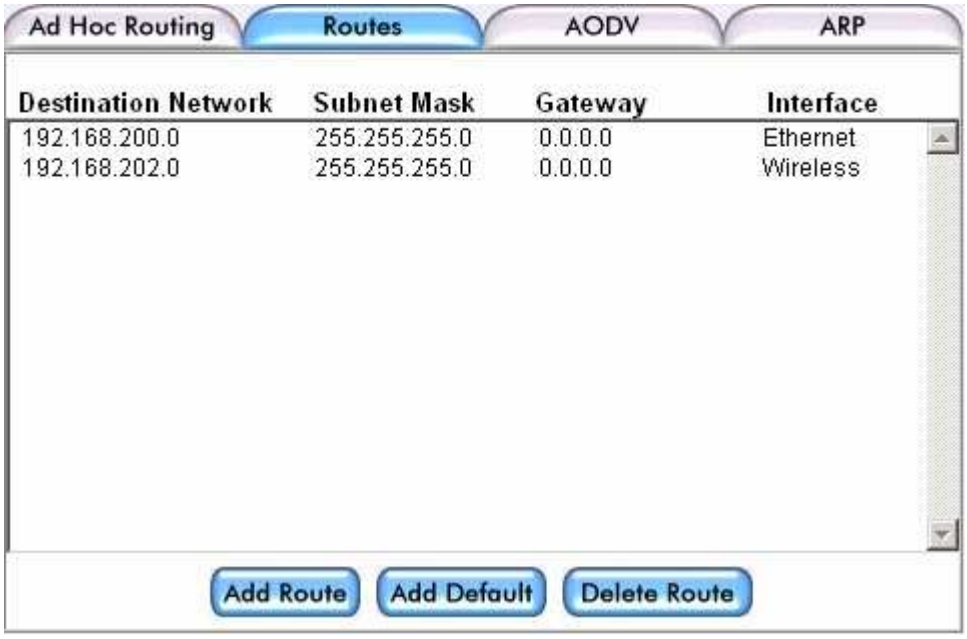

Figure 18: *NovaRoam* Configuration Routes Tab

Option Name	What it Does
Add Route	Opens the Add Route window. Used to manually enter static routes.
Add Default	Opens the Add Default window. Used to manually enter default gateways.
Delete Route	Manually deletes routes. To delete a route, select the route from the route table. After the route is highlighted, click on the Delete Route button. The route is then deleted from the route table.

Figure 19: *NovaRoam* Configuration Add Route Window

Option Name	What it Does
Network	Specifies the destination network for the route being created
Subnet Mask	Specifies the subnet mask of the destination network for which the route is being created
Gateway	Specifies the next hop gateway of the destination network for which the route is being created
Apply	Adds the route to the route table. Static routes remain in the route table until they are manually deleted.
Cancel	Closes the Add Route window without adding a route to the route table

Figure 20: *NovaRoam* Configuration Add Default Window

Option Name	What it Does
Gateway	Specifies the default gateway. This is the IP address to which all data packets without an existing route are sent.
Apply	Adds the default gateway to the route table. The default gateway will remain in the route table until it is manually deleted.
Cancel	Closes the Add Default window without adding a default gateway to the route table

AODV Tab

The AODV tab lets you configure parameters associated with the operation of the AODV (Ad hoc On-demand Distance Vector) ad hoc routing algorithm. The default settings have been set for a typical mobile network environment and should not need to be changed. However, modification of these parameters is supported in the event that your wireless network requires tweaking of the internal algorithm values to best match your network architecture.

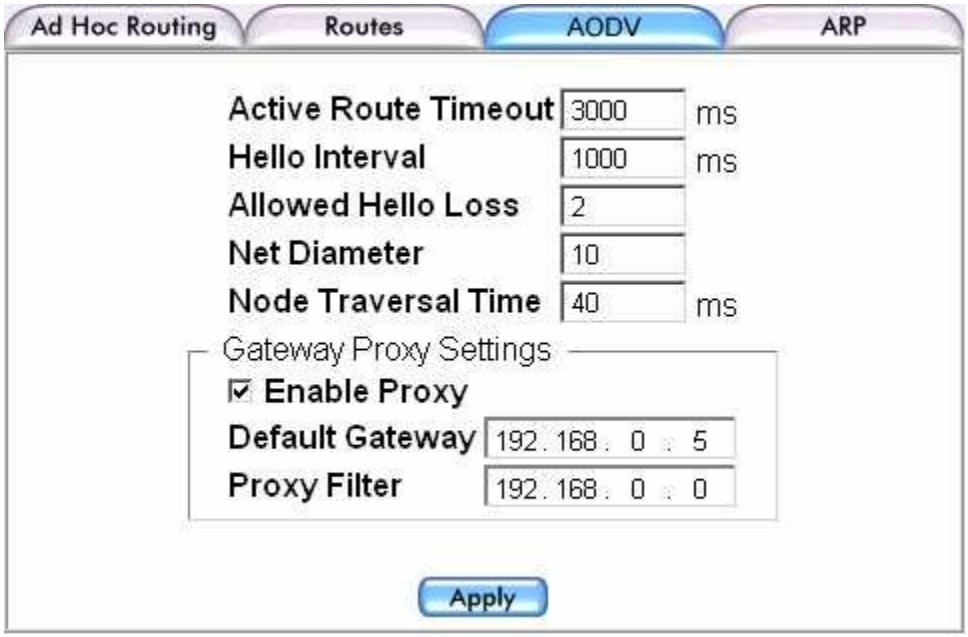

Figure 21: *NovaRoam* Configuration AODV Tab

Option Name	What it Does
Active Route Timeout	Determines the time period that a route will remain in the routing table when no traffic is being sent to the destination. The valid range of values is between 1000 and 100000 milliseconds. The default value is 3000 milliseconds.
Hello Interval	Displays the time between “hello” beacon messages. This valid range of values is between 1000 and 100000 milliseconds. The default value is 1000 milliseconds.
Allowed Hello Loss	Specifies the number of “hello” messages which, when missed, determines a link failure. The valid range of values is from 1 to 10. The default value is 2.
Net Diameter	Determines the maximum number of hops for which routes will be created. The valid range of values is from 3 to 100. The default value is 10.
Node Traversal Time	Provides an estimate of the time required to traverse a node. This value is used to form an estimate of the time it takes for a route discovery packet (RREQ) to traverse the network and return a reply (RREP). The node generating the request uses this estimate to determine when to give up and send another request. The valid range of value is from 10 to 1000 milliseconds. The default value is 40 milliseconds.
Enable Proxy	Enable Proxy specifies the NovaRoam as a proxy server for public Internet access. This option should only be selected on NovaRoams that will act as a proxy for other NovaRoams.
Default Gateway	Specifies the default gateway used by the proxy to access the Internet. The default gateway address should be the address of a router that is physically connected to the Internet.

Option Name	What it Does
Proxy Filter	The Proxy Filter setting defines which networks are available on the wireless network. For best results, the Ethernet interfaces of all NovaRoam should be on similar subnets. For example, Node 1 may be on the 192.168.200.0 network, while Node 2 is on the 192.168.201.0 network. In this situation, the proxy filter should be set to 192.168.0.0.
Apply	Applies changes made to the AODV configuration page.

ARP Tab

The ARP (Address Resolution Protocol) tab allows you to insert and view static ARP entries. ARP entries consist of an IP address and its associated MAC address. ARP entries associated with typical operation are not displayed on the ARP tab. This tab is only used in situations where static ARP entries are required.

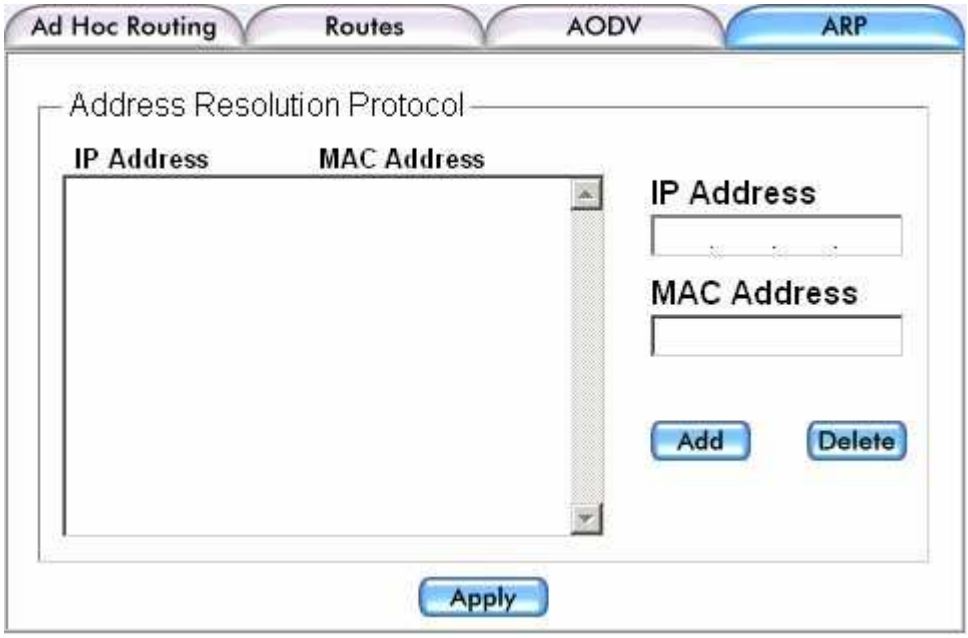

Figure 22: *NovaRoam* Configuration ARP Tab

Option Name	What it Does
IP Address	Specifies the IP address of the ARP entry that is being created
MAC Address	Specifies the MAC address of the ARP entry that is being created
Add	Adds the ARP entry to the ARP table
Delete	Deletes an ARP entry from the ARP table. To delete an ARP entry, select it from the ARP table then click on the Delete button
Apply	Applies changes to the ARP configuration page

QoS Configuration Page

The QoS page allows you to configure Quality of Service (QoS) settings.

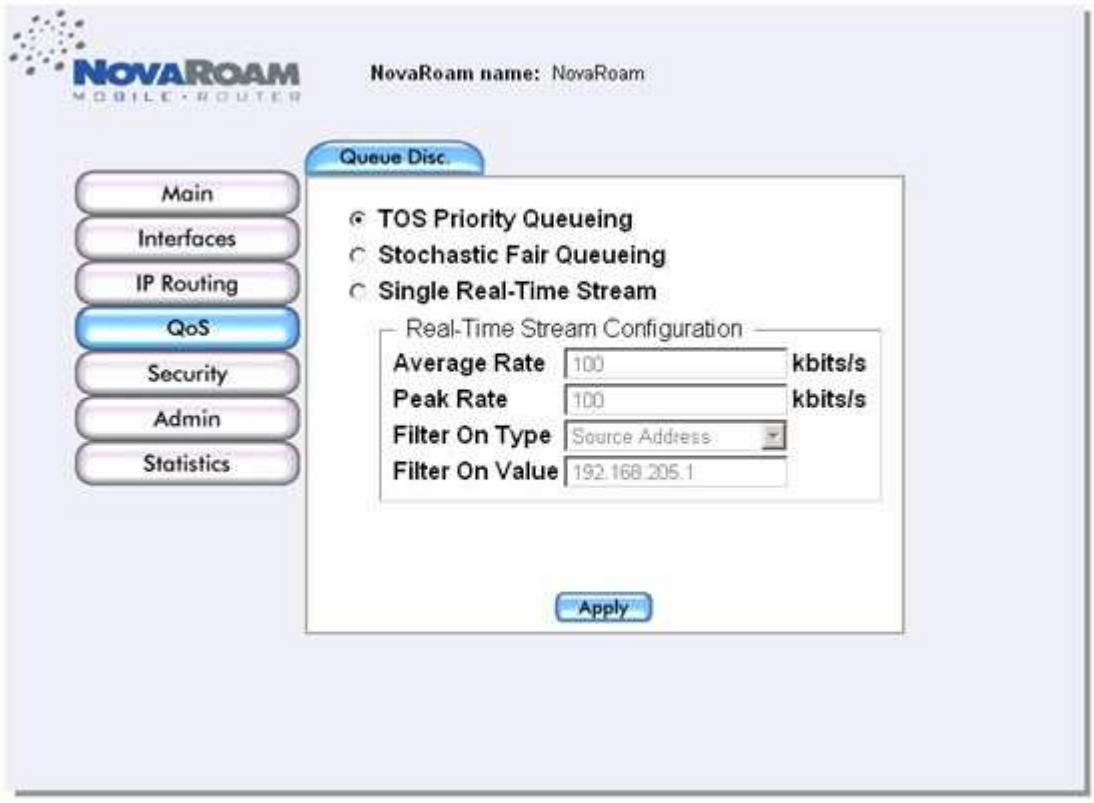

Figure 23: *NovaRoam* Configuration QoS Page

Queue Disc. Tab

The Queue Disc. Tab allows you to select and configure the QoS Queue Discipline options.

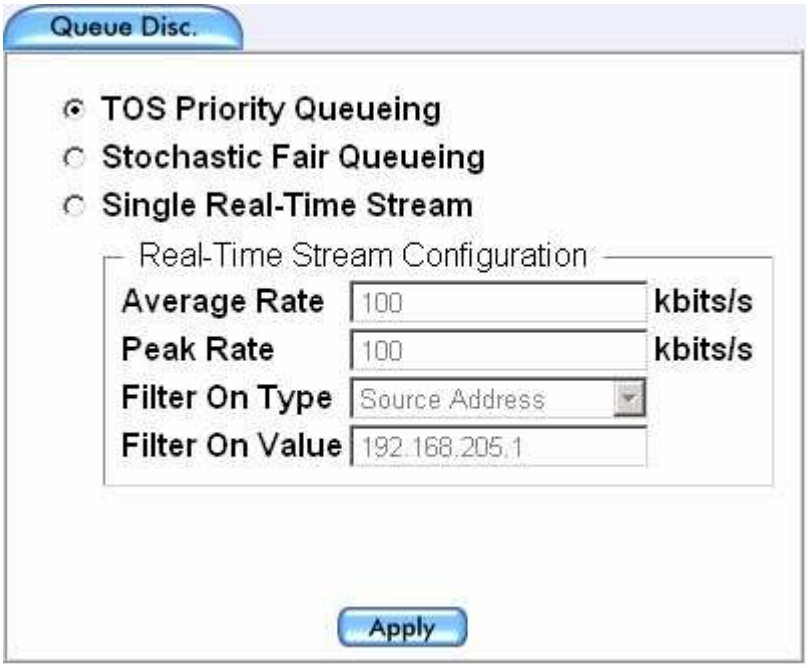

Figure 24: *NovaRoam* Configuration Queue Disc. Tab

Option Name	What it Does
TOS Priority Queuing	TOS (Type of Service) Priority Queuing uses the TOS field to provide priority queuing. The TOS bits can contain several options as defined by the Internet Engineering Task Force (IETF) RFC 1349.
Stochastic Fair Queuing	Stochastic Fair Queuing assigns priority based on data streams. Each data stream is given equal priority, meaning that no data stream receives privileged treatment. This is achieved by servicing one packet from stream 1, then a packet from stream 2 and so on, repeating once all streams have been serviced.
Single Real-Time Stream	Single Real-Time Stream queuing is used to specify a single stream that requires elevated priority above any other data.
Average Rate	Average rate is used to specify the average throughput of the Single Real-Time Stream that is receiving priority queuing.
Peak Rate	Peak rate is used to specify the peak throughput of the Single Real-Time Stream that is receiving priority queuing.
Filter On Type	When using the Single Real-Time Stream mechanism, traffic priority can be filtered by one of twelve options: Source Address, Destination Address, Any Source Port, Any Destination Port, UDP Source Port, UDP Destination Port, TCP Source Port, TCP Destination Port, TOS Field, Protocol Field, ICMP Message Type, ICMP Message Code. After selecting the filter type, assign the specific value in the Filter On Value field. For example, select Source Address from the Filter On Type field. In the Filter On Value field, specify the IP address to which you wish to assign priority.
Filter On Value	After selecting the filter type, use the Filter On Value field to assign the specific filter value.
Apply	Applies changes to the Queue Disc. configuration tab.

Security Page

The security page displays the current *NovaRoam* security settings. Encryption can be enabled and configured from this page. The *NovaRoam* provides 128-bit AES encryption for data security.

Figure 25: *NovaRoam* Configuration Security Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
IP Routing	Opens the IP Routing configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
Encryption	Opens the Encryption Configuration page
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be assigned to best suit your application.

Encryption Tab

The Encryption Tab allows you to enable or disable encryption. The encryption pass phrase can be entered or purged from this tab. As an additional security measure, the SHA-256 one-way hash algorithm is used to create the 128-bit key.

Figure 26: *NovaRoam* Configuration Encryption Tab

Option Name	What it Does
Enable	Enables 128-bit data encryption
Pass Phrase	Assigns encryption pass phrase. In order for *NovaRoams* to communicate using encryption, each *NovaRoam* must use the same pass phrase
Verify Pass Phrase	Verifies that encryption pass phrase has been entered properly
Purge Key	Purges the encryption key. Clicking on this button will remove the encryption key from the system. **Note: Do not click on the purge key button if there is not a key installed**. Doing so may damage the NovaRoam software. If a key is installed, ******* will be displayed in the pass phrase field.
Apply	Applies changes made to the Encryption configuration page

* 128-bit encryption provided using AES encryption algorithm. Not FIPS certified.

Admin Page

The Admin configuration allows you to configure the NovaRoam Name and change the system password. This page also allows the *NovaRoam* to be rebooted or reset to factory default settings. Firmware upgrades can be initiated from the Admin page. Configuration files can be downloaded or uploaded from the Admin page.

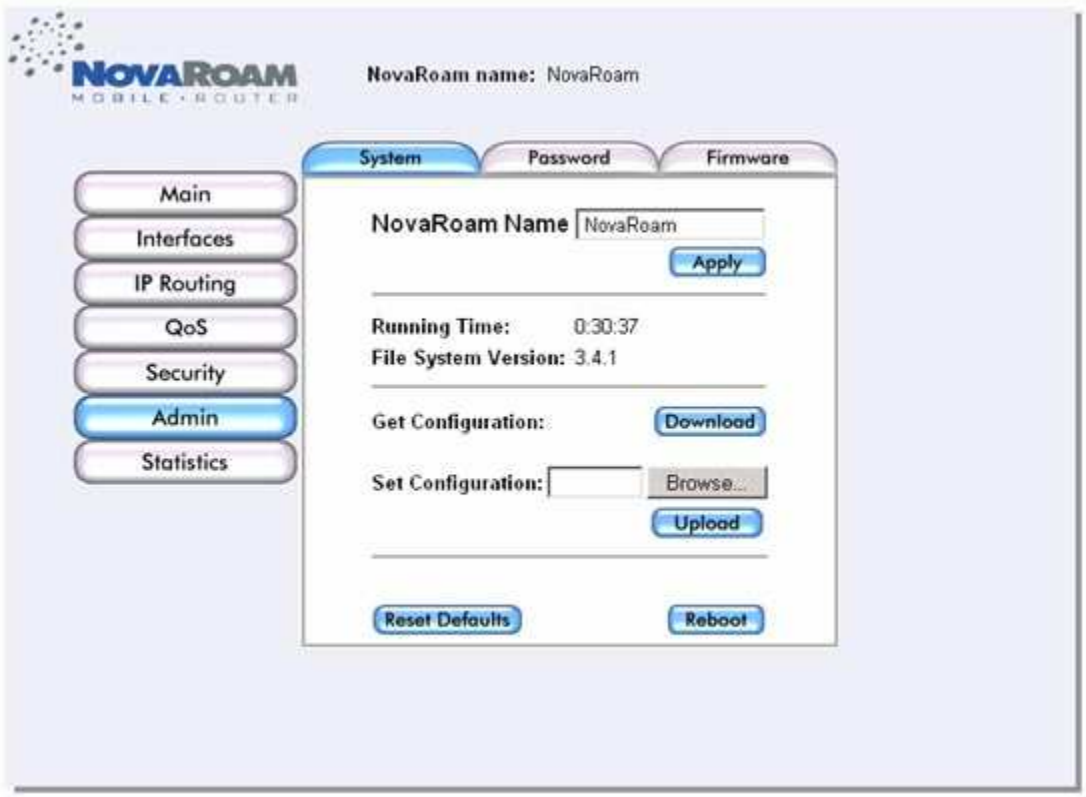

Figure 27: *NovaRoam* Configuration Admin Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
IP Routing	Opens the IP Routing configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
System	Opens the System Configuration page
Password	Opens the Password Configuration page
Firmware	Opens the Firmware Configuration page
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be assigned to best suit your application.

System Tab

The *NovaRoam* can be rebooted or to reset to factory default settings from the System tab. The System tab also allows you to assign a name to *NovaRoam* unit. Configuration files can also be downloaded or uploaded from the System tab.

Figure 28: *NovaRoam* Configuration System Tab

Option Name	What it Does
NovaRoam Name	Specifies the unique NovaRoam Name. Using an easy to remember NovaRoam Name, instead of trying to remember its IP address, can be very helpful while planning your network. To change the NovaRoam Name, enter the new name in the NovaRoam Name field then click on the Apply button. The NovaRoam Name can contain any ASCII value except '=' and '&'. After making changes to the NovaRoam Name, click on the Apply button to commit the changes.
Running Time	Displays the amount of time that has elapsed since the last system boot
File System Version	Displays the version of the file system that is currently installed
Get Configuration	This feature is used to display the current configuration parameters. Click on the Download button to display the parameters. The displayed parameters can be saved offline.
Set Configuration	This feature is used to upload new configuration parameters. Use the Browse button to specify the location of the configuration file. Click on the upload button to load the new configuration parameters into memory.
Reset Defaults	Resets all *NovaRoam* settings to their original factory default settings
Reboot	Reboots the *NovaRoam*

Password Tab

The Password tab enables you to change the current password for accessing the configuration web pages.

Figure 29: *NovaRoam* Configuration Password Tab

Option Name	What it Does
Enter Old Password	Permits entry of the old system password. The default system password is **novaroam**. It is strongly recommended that you change the system password
Enter New Password	Permits entry of the new system password.
Confirm New Password	Enables confirmation of the new system password. The software compares your new password to the one you enter for confirmation.
Apply	Applies password changes.

Firmware Tab

The Firmware tab allows you to update the *NovaRoam* firmware. It is important not to disturb the *NovaRoam* during the update process. Doing so may require the *NovaRoam* to be returned to the factory to be repaired

Figure 30: *NovaRoam* Configuration Firmware Tab

Option Name	What it Does
File	Use the Browse button to specify the location of the firmware file to be uploaded.
Upgrade	After specifying the location of the firmware file, click on the Upgrade button to start the firmware upgrade process. **DO NOT** disturb the *NovaRoam* during the process, as doing so may require the *NovaRoam* to be returned to the factory to be repaired.

Firmware Upgrade Process

Use the Browse button to specify the location of the firmware file. After specifying the file, click on the Upgrade button to begin the upgrade process.

After you click on the Upgrade button, the progress meter displays the file download progress.

Figure 31: File Download Progress Screen

Upon completing the file download, an integrity check is performed on the firmware file. This is to insure that the firmware file is not corrupt.

Figure 32: Firmware File Integrity Check Indicator

After file integrity has been verified, the current file system is erased.

Figure 33: Erasing Current File System Display

Finally, the new file system will be written to the *NovaRoam*.

Figure 34: Writing New File System Display

To complete the upgrade, you will be prompted to reboot the *NovaRoam*.

Figure 35: Prompt to Reboot *NovaRoam*

After the *NovaRoam* reboots, the firmware upgrade process will be complete.

Statistics Page

The Statistics page displays *NovaRoam* statistics. Statistics are available for the wireless and Ethernet interfaces, as well as UDP, TCP, IP, ICMP and AODV statistics. The system log can be viewed from the Statistics page. The Signal Strength Display can be started from the Statistics page.

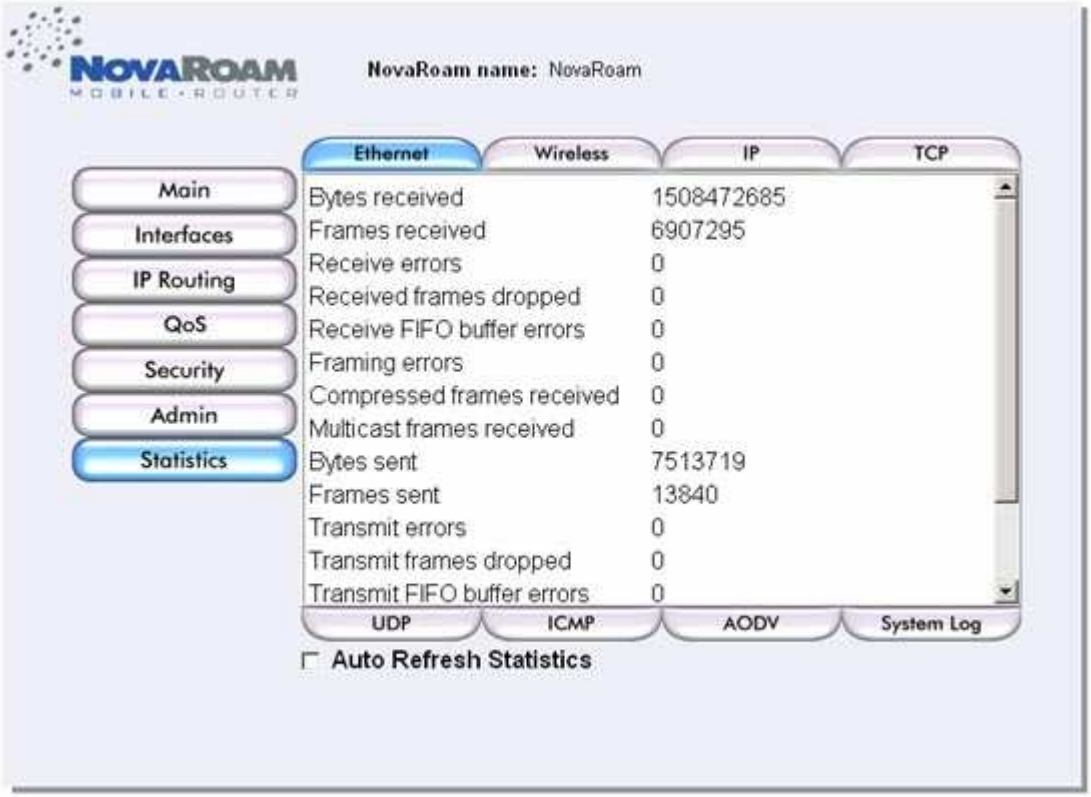

Figure 36: *NovaRoam* Configuration Statistics Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
IP Routing	Opens the IP Routing configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
Ethernet	Displays the Ethernet Interface statistics page
Wireless	Displays the Wireless Interface statistics page
IP	Displays the IP statistics page
TCP	Displays the TCP statistics page
UDP	Displays the UDP statistics page
ICMP	Displays the ICMP statistics page
AODV	Displays the AODV statistics page
System Log	Displays the System Log
Auto Refresh Statistics	Selecting this option allows the active statistic window to automatically refresh its statistics.
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be assigned to best suit your application.

Operation Mode: Bridge

In Bridge Mode, the NovaRoam provides a wireless connection between two or more segments of the same IP subnet.

Main Configuration Page

The Main configuration page allows you to specify the operation mode. The Setup Wizard can also be started from this page. Selecting one of the navigation buttons on the left side of the configuration page allows the user to configure the various elements of the NovaRoam.

Figure 39: *NovaRoam* Configuration Main Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
Setup Wizard	Starts *NovaRoam* Setup Wizard
Operation Mode	Specifies the operation mode of the *NovaRoam*. The *NovaRoam* can operate as a router or as a bridge.
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be changed to best suit your application.

Using the Setup Wizard

The Setup Wizard simplifies *NovaRoam* configuration by presenting common setup parameters in an easily understandable format. The Setup Wizard can be started by clicking on the Setup Wizard button on the Main configuration page.

NOVAROAM
MOBILE • ROUTER
Welcome to the NovaRoam Setup Wizard. This wizard will help you quickly configure your NovaRoam.
To continue, press 'Next'.
Next

Figure 40: Setup Wizard Start Page

At the opening screen of the setup wizard, click on the Next button to start configuring the *NovaRoam*.

You can cancel the Setup Wizard at anytime by closing the Setup Wizard window. Changes are not committed unless the Setup Wizard is completed.

NOVAROAM
MOBILE • ROUTER
Choose Operation Mode
Choose 'Bridge' if you require the NovaRoam to act as a bridge.
Choose 'Router' if you require the NovaRoam to act as a router.
Bridge
Back
Next

Figure 41: Setup Wizard Operation Mode Selection

The *NovaRoam EH900* can operate as a router or as a bridge. As a **Router**, the *NovaRoam* routes traffic between different IP Subnets. As a **Bridge**, the *NovaRoam* connects different segments of the same IP subnet.

After specifying the Operation Mode, click on the Next button.

Figure 42: Setup Wizard Date Rate Selection Page

The *NovaRoam EH900* can be configured to one of two data rates, 100 kbps or 400 kbps. After specifying the Data Rate, click on the Next button.

Note: All *NovaRoams* that are required to communicate with each other must specify the same data rate.

Figure 43: Setup Wizard Network ID Selection Page

Specify the Network ID for the *NovaRoam*. In order for *NovaRoams* to communicate with each other, they must use the same Network ID. Networks can be collocated by using a separate Network ID for each individual network.

After specifying the Network ID, click on the Next button.

Figure 44: Setup Wizard Bridge Interface IP Address Configuration Page

Specify the IP address and corresponding Subnet Mask for the Bridge Interface. After specifying the address, click on the Next button.

NOVAROAM
MOBILE • ROUTER
Finish
Congratulations, you have completed the NovaRoam Setup Wizard.
Press the "Finish" button to save changes and return to the main configuration page.
Back
Finish

Figure 45: Setup Wizard Finish Page

Click on the Finish button to complete the setup wizard and return to the main configuration page. If more detailed configuration is required, additional setup options are available from the main configuration page.

Interfaces Configuration Page

The Interfaces Configuration page allows configuration of the Bridge and Serial interfaces of the *NovaRoam*.

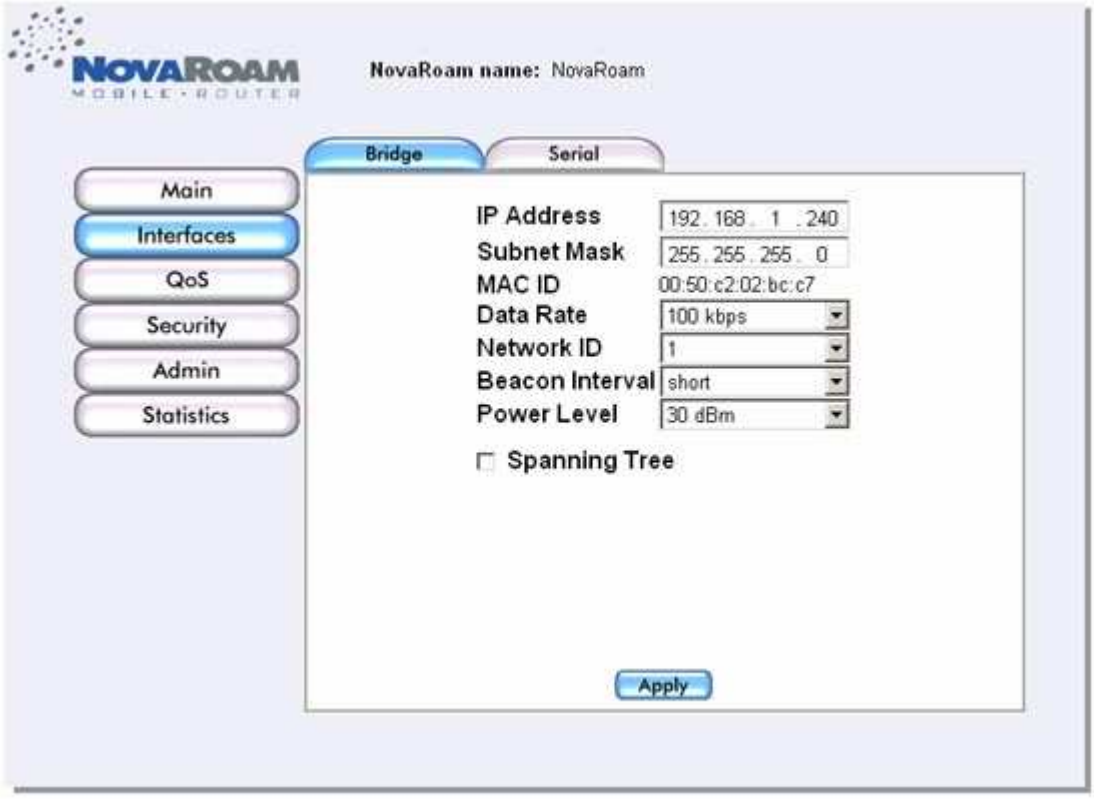

Figure 46: *NovaRoam* Configuration Interfaces Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
Bridge	Opens the Bridge Interface Configuration tab
Serial	Opens the Serial Interface Configuration tab
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be assigned to best suit your application.

Bridge Tab

The Bridge tab lets you specify the IP address, subnet mask, maximum transfer unit (MTU), and various wireless options for the bridge network interface.

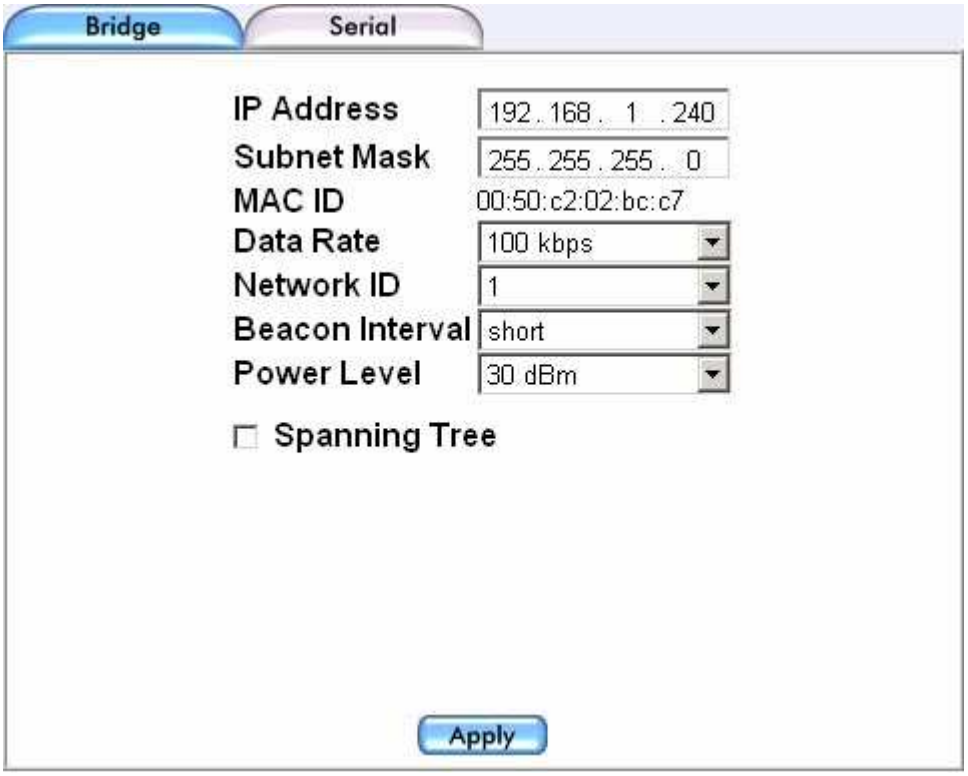

Figure 47: *NovaRoam* Configuration Bridge Tab

Option Name	What it Does
IP Address	Specifies the IP address of the Bridge Interface. The default IP address is 192.168.200.1.
Subnet Mask	Specifies the Subnet Mask of the Bridge Interface
MAC ID	This *read-only* field specifies the unique Media Access Control (MAC) address of the *NovaRoam* Bridge Interface.
Data Rate	Specifies the over-the-air (burst) Data Rate of the *NovaRoam*. Data Rates can be specified as 100 kbps, or 400 kbps. The default data rate is 100 kbps.
Network ID	Specifies the Network ID for the *NovaRoam*. In order to communicate with each other, *NovaRoams* must use the same Network ID. Networks can be collocated by using a separate Network ID for each individual network.
Beacon Interval	Specifies the amount of time between beacon transmissions. Options are short and long.
Power Level	Specifies the output power of the *NovaRoam*. Options are 10 dBm, 20 dBm, 25 dBm, and 30 dBm.
Spanning Tree	Enables the Spanning Tree Protocol (STP). STP generates beacon messages between bridges in order to eliminate forwarding loops. If more than one *NovaRoam* is used per Ethernet Segment, enabling STP is recommended. If only one *NovaRoam* is used per Ethernet segment, STP is not recommended. Use of STP increases RF overhead.
Apply	Applies changes made to the Bridge Interface configuration page

Serial Tab

The serial interface of a *NovaRoam* can be used to tunnel raw asynchronous serial data to another *NovaRoam*. The Serial tab allows you to configure the various port settings of the asynchronous serial interface as well as the destination *NovaRoam* address and port number.

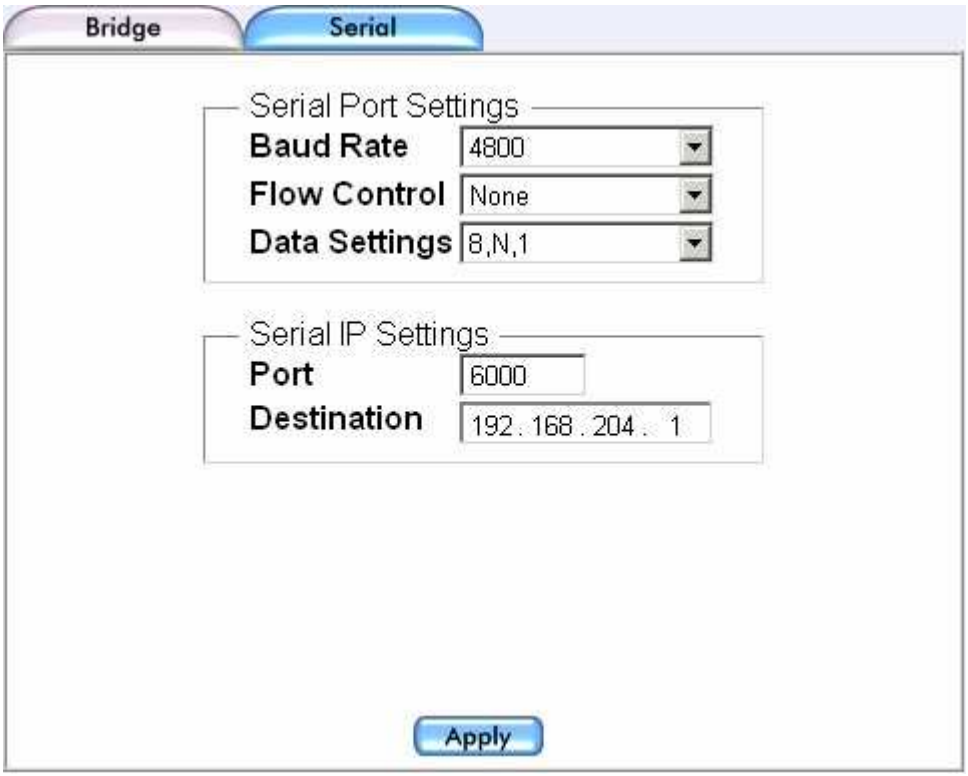

Figure 49: *NovaRoam* Configuration Serial Tab

Option Name	What it Does
Baud Rate	Specifies the baud rate of the serial interface. Available baud rates are 2400, 4800, 9600, 19200, 38400, 57600, and 115200. The default setting is 4800.
Flow Control	Determines whether or not flow control is used on the *NovaRoam* serial interface. Options are None or Hardware. The default setting is None.
Data Settings	Specifies the data settings, specifically data bits, parity, and stop bits. Options are 8,N,1 / 7,E,1 / 7,O,1. The default setting is 8,N,1.
Port	Specifies the port that serial data is sent to and received from. The default port number is 6000. In order for multiple *NovaRoams* to communicate serial data, the same port must be specified on each *NovaRoam.*
Destination	Displays the Destination IP address to which all serial data is sent. The default Destination IP address is 192.168.204.1. Specifying the Wireless Interface of a *NovaRoam* causes serial data to be sent out the serial port of the receiving *NovaRoam*. Specifying the Ethernet Interface of a *NovaRoam* or other device causes serial data to be sent out the Ethernet Interface of the receiving *NovaRoam.*
Apply	Applies changes made to the Serial Interface configuration page

QoS Configuration Page

The QoS page allows you to configure Quality of Service (QoS) settings.

Figure 50: *NovaRoam* Configuration QoS Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
Queue Disc.	Opens the Queue Discipline Configuration tab
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be assigned to best suit your application.

Queue Disc. Tab

The Queue Disc. Tab allows you to select and configure the QoS Queue Discipline options.

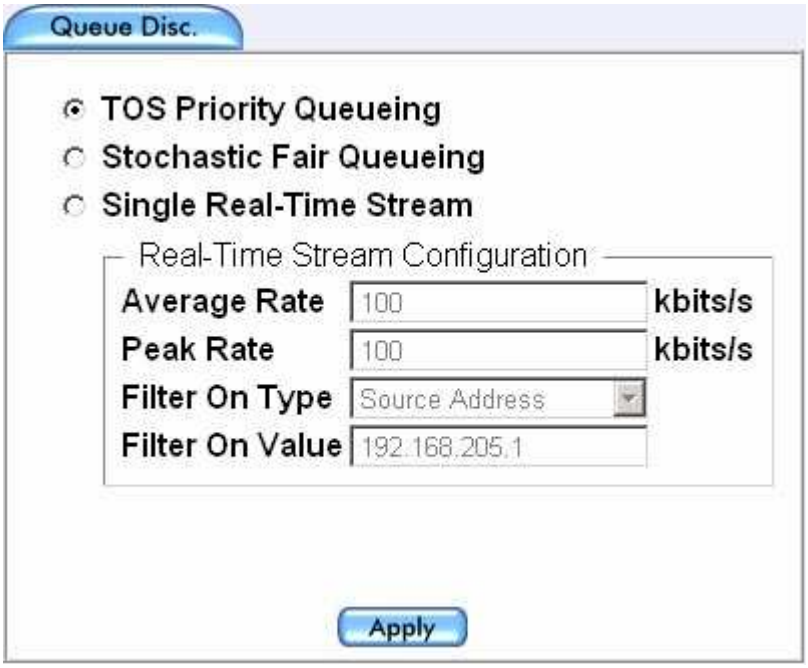

Figure 51: *NovaRoam* Configuration Queue Disc. Tab

Option Name	What it Does
TOS Priority Queuing	TOS (Type of Service) Priority Queuing uses the TOS field to provide priority queuing. The TOS bits can contain several options as defined by the Internet Engineering Task Force (IETF) RFC 1349.
Stochastic Fair Queuing	Stochastic Fair Queuing assigns priority based on data streams. Each data stream is given equal priority, meaning that no data stream receives privileged treatment. This is achieved by servicing one packet from stream 1, then a packet from stream 2 and so on, repeating once all streams have been serviced.
Single Real-Time Stream	Single Real-Time Stream queuing is used to specify a single stream that requires elevated priority above any other data.
Average Rate	Average rate is used to specify the average throughput of the Single Real-Time Stream that is receiving priority queuing.
Peak Rate	Peak rate is used to specify the peak throughput of the Single Real-Time Stream that is receiving priority queuing.
Filter On Type	When using the Single Real-Time Stream mechanism, traffic priority can be filtered by one of twelve options: Source Address, Destination Address, Any Source Port, Any Destination Port, UDP Source Port, UDP Destination Port, TCP Source Port, TCP Destination Port, TOS Field, Protocol Field, ICMP Message Type, ICMP Message Code. After selecting the filter type, assign the specific value in the Filter On Value field. For example, select Source Address from the Filter On Type field. In the Filter On Value field, specify the IP address to which you wish to assign priority.
Filter On Value	After selecting the filter type, use the Filter On Value field to assign the specific filter value.
Apply	Applies changes to the Queue Disc. configuration tab.

Security Page

The security page displays the current *NovaRoam* security settings. Encryption can be enabled and configured from this page. The *NovaRoam* provides 128-bit AES encryption for data security.

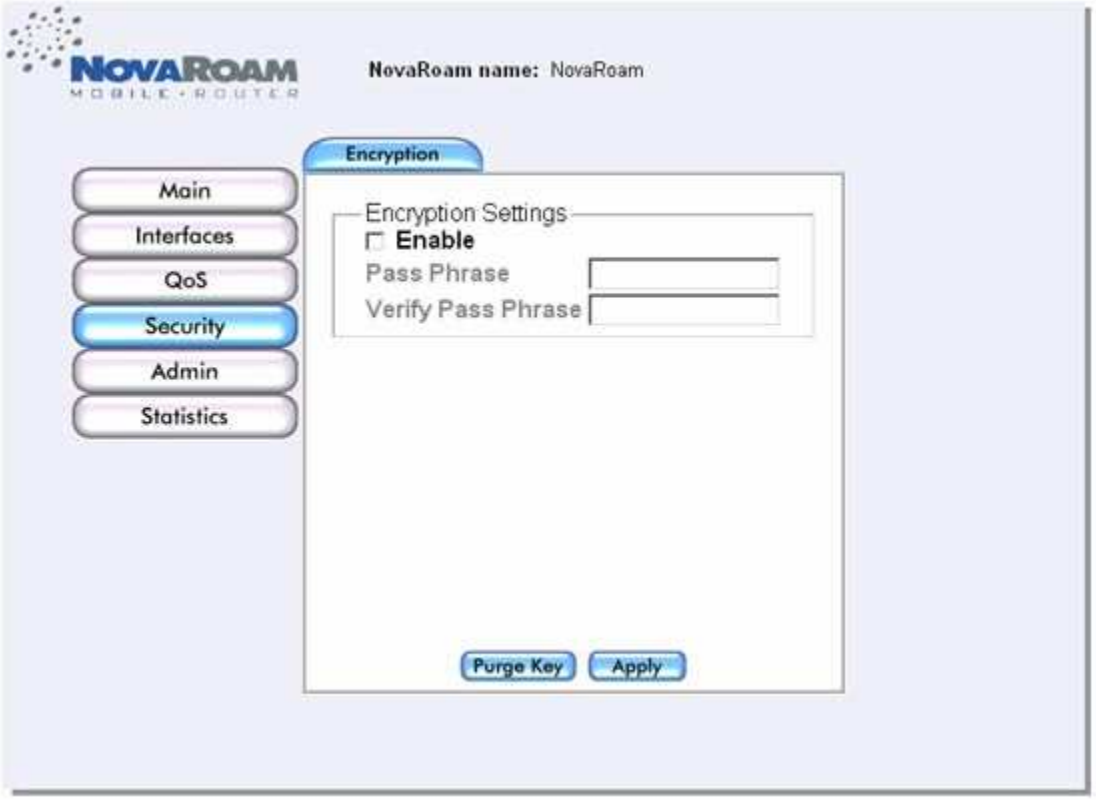

Figure 51: *NovaRoam* Configuration Security Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
Encryption	Opens the Encryption Configuration page
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be assigned to best suit your application.

Encryption Tab

The Encryption Tab allows you to enable or disable encryption. The encryption pass phrase can be entered or purged from this tab. As an additional security measure, the SHA-256 one-way hash algorithm is used to create the 128-bit key.

Figure 53: NovaRoam Configuration Encryption Tab

Option Name	What it Does
Enable	Enables 128-bit data encryption
Pass Phrase	Assigns encryption pass phrase. In order for *NovaRoams* to communicate using encryption, each *NovaRoam* must use the same pass phrase
Verify Pass Phrase	Verifies that encryption pass phrase has been entered properly
Purge Key	Purges the encryption key. Clicking on this button will remove the encryption key from the system. **Note: Do not click on the purge key button if there is not a key installed**. Doing so may damage the NovaRoam software. If a key is installed, ******* will be displayed in the pass phrase field.
Apply	Applies changes made to the Encryption configuration page

* 128-bit encryption provided using AES encryption algorithm. Not FIPS certified.

Admin Page

The Admin configuration allows you to configure the NovaRoam Name and change the system password. This page also allows the *NovaRoam* to be rebooted or reset to factory default settings. Firmware upgrades can be initiated from the Admin page. Configuration files can be downloaded or uploaded from the Admin page.

Figure 54: *NovaRoam* Configuration Admin Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
System	Opens the System Configuration page
Password	Opens the Password Configuration page
Firmware	Opens the Firmware Configuration page
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be assigned to best suit your application.

System Tab

The *NovaRoam* can be rebooted or to reset to factory default settings from the System tab. The System tab also allows you to assign a name to *NovaRoam* unit. Configuration files can also be downloaded or uploaded from the System tab.

Figure 55: *NovaRoam* Configuration System Tab

Option Name	What it Does
NovaRoam Name	Specifies the unique NovaRoam Name. Using an easy to remember NovaRoam Name, instead of trying to remember its IP address, can be very helpful while planning your network. To change the NovaRoam Name, enter the new name in the NovaRoam Name field then click on the Apply button. The NovaRoam Name can contain any ASCII value except '=' and '&'. After making changes to the NovaRoam Name, click on the Apply button to commit the changes.
Running Time	Displays the amount of time that has elapsed since the last system boot
File System Version	Displays the version of the file system that is currently installed
Get Configuration	This feature is used to display the current configuration parameters. Click on the Download button to display the parameters. The displayed parameters can be saved offline.
Set Configuration	This feature is used to upload new configuration parameters. Use the Browse button to specify the location of the configuration file. Click on the upload button to load the new configuration parameters into memory.
Reset Defaults	Resets all *NovaRoam* settings to their original factory default settings
Reboot	Reboots the *NovaRoam*

Password Tab

The Password tab enables you to change the current password for accessing the configuration web pages.

Figure 56: *NovaRoam* Configuration Password Tab

Option Name	What it Does
Enter Old Password	Permits entry of the old system password. The default system password is **novaroam**. It is strongly recommended that you change the system password
Enter New Password	Permits entry of the new system password.
Confirm New Password	Enables confirmation of the new system password. The software compares your new password to the one you enter for confirmation.
Apply	Applies password changes.

Firmware Tab

The Firmware tab allows you to update the *NovaRoam* firmware. It is important not to disturb the *NovaRoam* during the update process. Doing so may require the *NovaRoam* to be returned to the factory to be repaired

Figure 57: *NovaRoam* Configuration Firmware Tab

Option Name	What it Does
File	Use the Browse button to specify the location of the firmware file to be uploaded.
Upgrade	After specifying the location of the firmware file, click on the Upgrade button to start the firmware upgrade process. **DO NOT** disturb the *NovaRoam* during the process, as doing so may require the *NovaRoam* to be returned to the factory to be repaired.

Firmware Upgrade Process

Use the Browse button to specify the location of the firmware file. After specifying the file, click on the Upgrade button to begin the upgrade process.

After you click on the Upgrade button, the progress meter displays the file download progress.

Figure 58: File Download Progress Screen

Upon completing the file download, an integrity check is performed on the firmware file. This is to insure that the firmware file is not corrupt.

Figure 59: Firmware File Integrity Check Indicator

After file integrity has been verified, the current file system is erased.

Figure 60: Erasing Current File System Display

Finally, the new file system will be written to the *NovaRoam*.

Figure 61: Writing New File System Display

To complete the upgrade, you will be prompted to reboot the *NovaRoam*.

Figure 62: Prompt to Reboot *NovaRoam*

After the *NovaRoam* reboots, the firmware upgrade process will be complete.

Statistics Page

The Statistics page displays *NovaRoam* statistics. Statistics are available for the wireless and Ethernet interfaces, as well as UDP, TCP, IP, ICMP and AODV statistics. The system log can be viewed from the Statistics page. The Signal Strength Display can be started from the Statistics page.

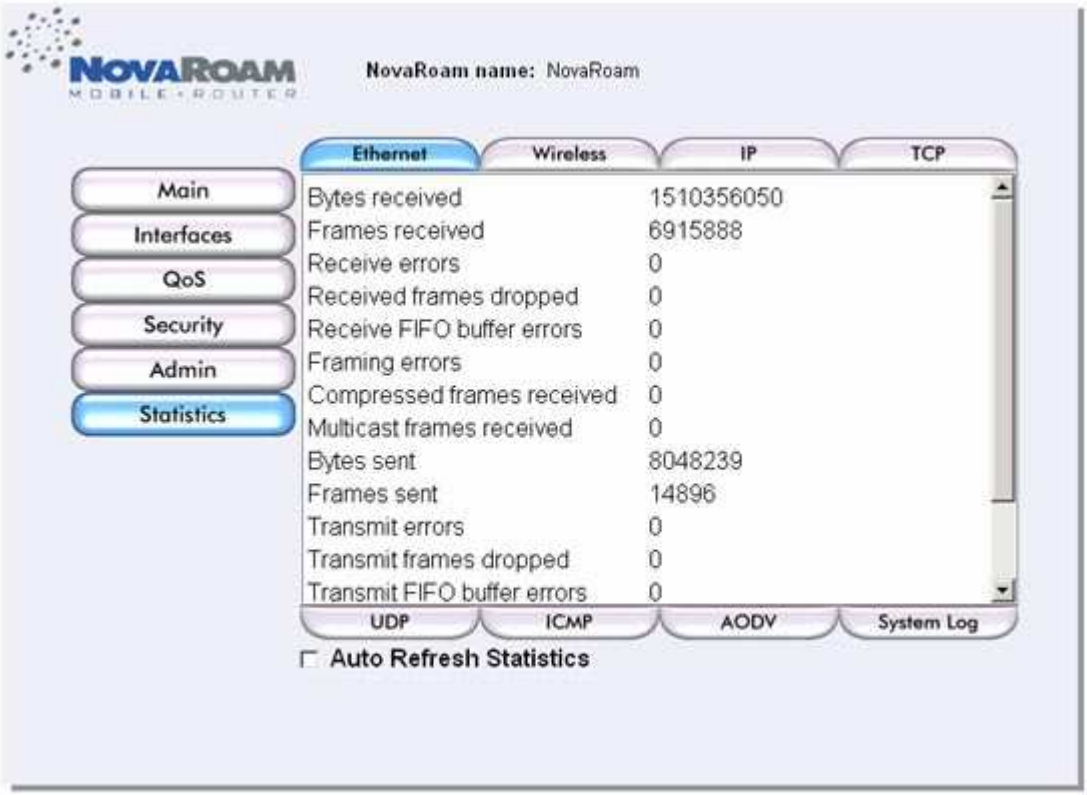

Figure 63: *NovaRoam* Configuration Statistics Page

Option Name	What it Does
Main	Opens the Main configuration page
Interfaces	Opens the Interfaces configuration page
QoS	Opens the QoS (Quality of Service) configuration page
Security	Opens the Security configuration page
Admin	Opens the Admin configuration page
Statistics	Opens the Statistics page
Ethernet	Displays the Ethernet Interface statistics page
Wireless	Displays the Wireless Interface statistics page
IP	Displays the IP statistics page
TCP	Displays the TCP statistics page
UDP	Displays the UDP statistics page
ICMP	Displays the ICMP statistics page
AODV	Displays the AODV statistics page
System Log	Displays the System Log
Auto Refresh Statistics	Selecting this option allows the active statistic window to automatically refresh its statistics.
NovaRoam Name	Displays the NovaRoam Name. The NovaRoam Name can be assigned to best suit your application.

Regulatory Information

FCC Warning

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference and 2) this device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications to this device without the express written consent of Nova Engineering, Inc. may void the user's authority to operate the device.

This device must be professionally installed. It is the responsibility of the installer to ensure that proper antenna and cable combinations are used in order to remain within FCC Part 15 limits.

The *NovaRoam EH900* is specifically designed to close the longest possible links. This goal is accomplished in part by delivering the highest permissible RF output power to the antenna per the FCC Part 15 Rules. In August 1996, the FCC adopted RF exposure guidelines that established safety levels for various categories of wireless transceivers. Those limits are consistent with safety standards previously published by the National Council on Radiation Protection (NCRP) Report 86, §17.4.1, §17.4.1.1, §17.4.2, and §17.4.3 as well as the American National Standards Institute (ANSI) in §4.1 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz," ANSI/IEEE C95.1-1992.

The *NovaRoam EH900* complies with these FCC exposure guidelines when the following precautions are obeyed:

- Only install the exact antennas recommended in this User Manual.
- The cable run for the selected antenna must exceed the minimum length quoted in this User Manual.

- All persons must maintain a minimum separation of 12" (30.48cm) from any *NovaRoam EH900* antenna.

You should disconnect the AC/DC input power source from the *NovaRoam EH900* whenever repositioning the antenna. You are responsible for taking the necessary steps to ensure that these guidelines are communicated to all persons that may come near the *NovaRoam EH900* antennas.

Class A Digital Devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device , pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Table 3: Approved Antennas

Description	Part Number
+2.2 dBi flexible antenna	NR-AAT-9M02FD000
+5.2 dBi magnetic mount collinear whip	NR-AAT-9M05WM012
+8.2 dBi omni, 60' LMR-400 cable	NR-AAT-9M08MN060
+11.2 dBi Yagi, 130' LMR-400 cable	NR-AAT-9M11YN130

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Appendix A: Example Network Plan

The use of private IP addresses is strongly recommended when configuring a *NovaRoam* network. The following example of a *NovaRoam* network uses several private IP subnets from the 192.168.0.0 block of private addresses.

The *NovaRoam* network depicted in Figure 63 contains three Ethernet segments. The first segment uses the 192.168.200.0 Class C subnet, encompassing a range of addresses from 192.168.200.1 to 192.168.200.254. The second segment uses the 192.168.201.0 Class C subnet, encompassing a range of addresses from 192.168.201.1 to 192.168.201.254. The third segment uses the 192.168.202.0 Class C subnet, encompassing a range of addresses from 192.168.202.1 to 192.168.202.254. All three segments share the 192.168.203.0 Class C subnet for their wireless interfaces. It is over this common subnet that traffic is routed between Ethernet segments.

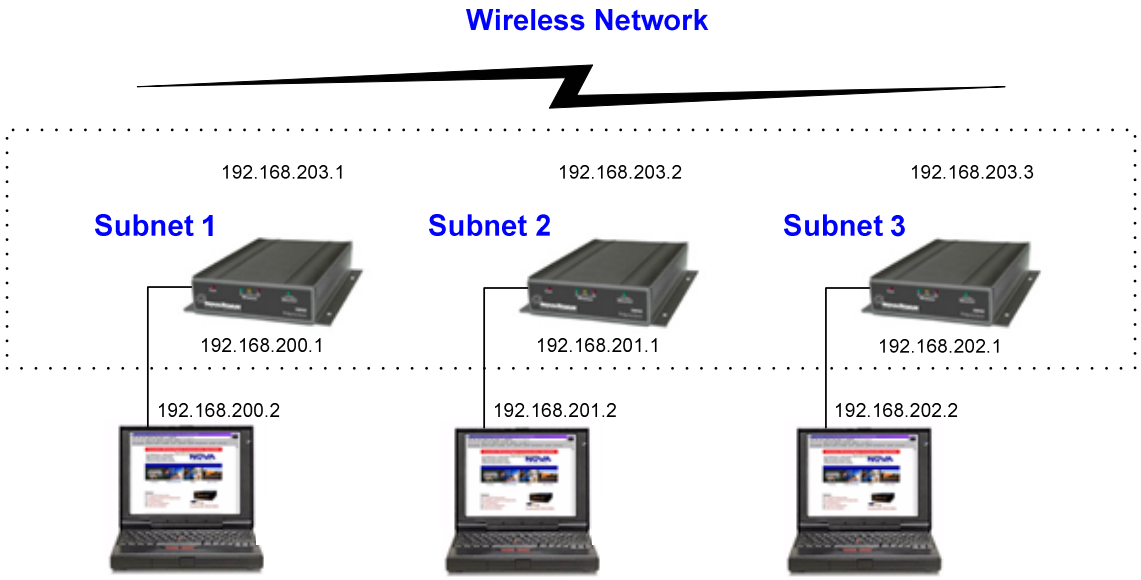


Figure 63: Multi-Network *NovaRoam* Example

Once the individual networks are established, it is recommended that you plan an IP addressing scheme. In the example from Figure 63, each *NovaRoam* host ID is 1, while the computer's host ID is 2. Following a numbering scheme such as this will make it easier to keep track of which IP addresses are used for each device.

The wireless network in the example uses the 192.168.203.0 subnet. This subnet is different than the subnets used for the Ethernet segments. The wireless interface of the *NovaRoam* from Subnet 1 is assigned an address of 192.168.203.1. The wireless interface of the *NovaRoam* from Subnet 2 is assigned an address of 192.168.203.2. The wireless interface of the *NovaRoam* from Subnet 3 is assigned an address of 192.168.203.3.

You may find it helpful to draw a diagram as a planning aid when designing your wireless network. Such a diagram will not only help in planning the networks, it will act as a handy reference guide.

Appendix B: Routing Options

The *NovaRoam Mobile Router* provides a wireless connection between two or more separate Ethernet subnets. Data is then routed between the Ethernet subnets. Route information can be entered manually, or can be handled automatically by AODV, the *NovaRoam's* Mobile Ad hoc Networking (MANET) algorithm.

Choosing Routing Mode

As a router, the *NovaRoam* provides a wireless connection between two or more separate Ethernet subnets. Data is then routed between the Ethernet subnets. Route information can be entered manually, or can be processed automatically by AODV, the *NovaRoam's* Mobile Ad hoc Networking (MANET) algorithm.

The type of network you are designing will help determine the best routing mode to use. If the network consists of stationary *NovaRoams* that are communicating either point-to-point or point-to-multipoint, choose "Off" for Ad Hoc Routing mode. This allows you to insert static routes for each *NovaRoam* and its connected network. If routes are not required to change dynamically, "Off" is likely the best Ad Hoc Routing mode to choose.

If the network consists of mobile *NovaRoams*, choose "AODV" for Ad Hoc Routing mode. This mode allows the *NovaRoams* to automatically find their neighbors and update their route tables to reflect this. AODV allows *NovaRoams* to quickly and dynamically update their route tables as the network topology changes. For environments in which routes are required to change dynamically, such as in a mobile environment, AODV is typically the best Ad Hoc Routing mode to choose.

A third option is Multihop mode. In Multihop mode, all packets originating from the *NovaRoam* are designated as multihop packets. Any *NovaRoam* receiving a multihop packet will automatically repeat the packet. Multihop mode can be used in conjunction with other routing modes.

Using Static Routes

Figure 64 is an example of a point-to-point *NovaRoam* network. In this example, Subnet 1 has been assigned the 192.168.1.0 Class C subnet, while Subnet 2 has been assigned the 192.168.2.0 Class C subnet. For the wireless network the 192.168.3.0 Class C subnet has been assigned.

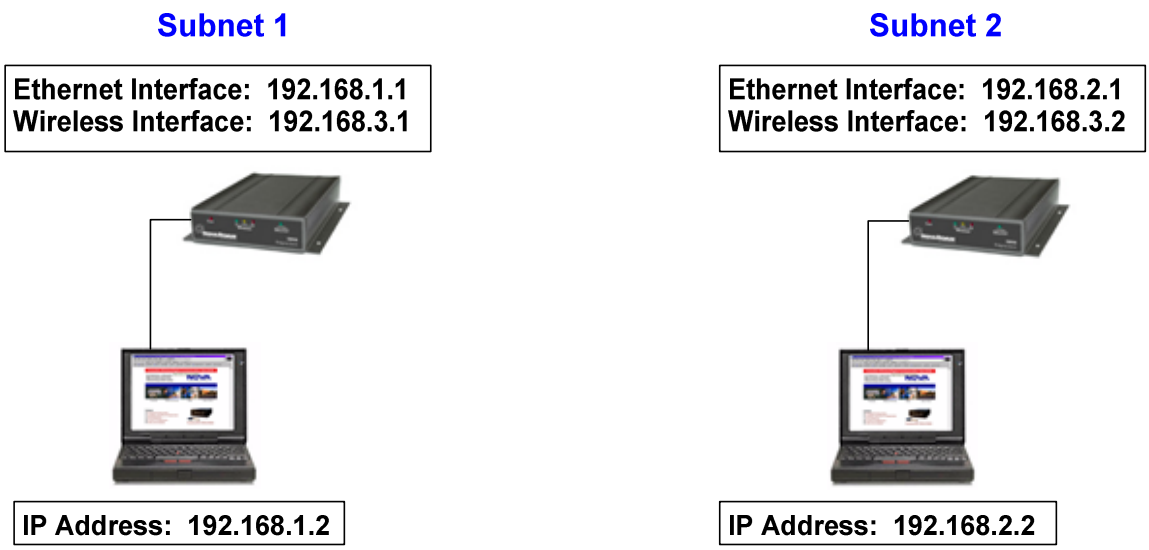


Figure 64: Example Wireless Network Using *NovaRoams* with Static Routes

In order to route traffic between subnets, several things must happen. First, it is recommended that all hosts on a given subnet use the attached *NovaRoam* as their default gateway. As an alternative, manual routes can be entered within each host's routing table. Hosts from Subnet 1 will list 192.168.1.1 as their default

gateway. It is also necessary to add static routes within each *NovaRoam*. The *NovaRoam* from Subnet 1 must have a static route to Subnet 2, using the wireless interface of the *NovaRoam* from Subnet 2 as the gateway. The route should be set up like this:

```
192.168.2.0     255.255.255.0     192.168.3.2     1
Network         Netmask           Gateway         Metric
```

It is recommended that all hosts from Subnet 2 use 192.168.2.1 as their default gateway. As an alternative, manual routes can be entered within each host's routing table. The *NovaRoam* from Subnet 2 must have a static route to Subnet 1, using the wireless interface of the *NovaRoam* from Subnet 1 as the gateway. This route should be set up like this:

```
192.168.1.0     255.255.255.0     192.168.3.1     1
Network         Netmask           Gateway         Metric
```

Note: It is important to understand that there are actually three subnets in this example: Subnet 1, Subnet 2, and the wireless network.

AODV

The *NovaRoam* uses a routing algorithm called AODV (Ad hoc On-demand Distance Vector) that works dynamically to establish and maintain routes. AODV is an "on demand" routing algorithm, meaning that it builds routes between nodes only as requested by source nodes. These routes are maintained only as long as required by the source nodes.

AODV creates routes using a route request / route reply query cycle. When a source node requires a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the wireless network. Nodes receiving this packet update their information for the source node and create reverse pointers to the source node in their route tables. A node that receives the RREQ will send a route reply (RREP) if it is either the destination or if it has a route to the destination with a corresponding sequence number greater than or equal to that contained in the RREQ. If this is the case, the node sends a

RREP back to the source node. Otherwise, it rebroadcasts the RREQ. Nodes keep track of the RREQ's source IP address and broadcast ID. If they receive a RREQ that has already been processed, they discard the RREQ and do not forward the packet.

As the RREP propagates back to the source, nodes create forward pointers to the destination. Upon receiving the RREP, the source node will begin forwarding data to the destination. If the source node later receives a RREP containing a greater sequence number or the same sequence number with a smaller hop count, it may update its routing information for that destination to use the better route.

Routes are maintained as long as they remain active. A route is considered active when data periodically travels from the source to the destination using the route. When the source stops sending data packets, the route will time out and eventually be deleted from the destination and intermediate node routing tables. If a link breakage occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the source node to inform it of the now unreachable destination(s). After receiving the RERR, the source node can reinitiate route discovery if the route is still required.

Figure 65 depicts an example of a simple network using AODV Routing. Subnets 1 and 2 are mobile subnets, while Subnet 3 is a fixed subnet on a wired network. With AODV Routing enabled, all subnets are able to communicate with each other. If Subnet 1 leaves the communications range of the Subnet 3, Subnet 1 automatically attempts to reach the fixed Subnet by routing packets through the Subnet 2.

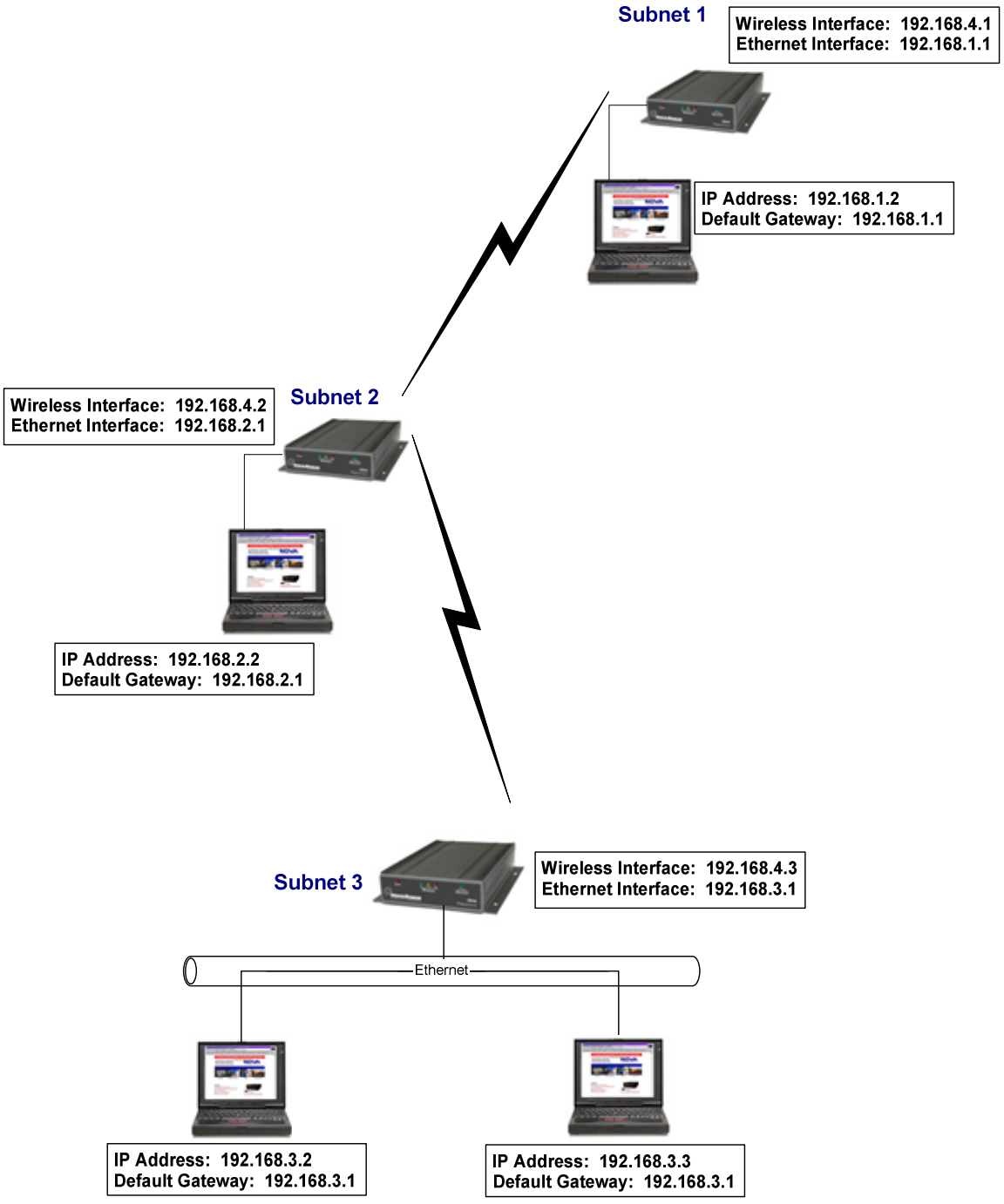


Figure 65: Example of Wireless Network Using *NovaRoams* with AODV

Appendix C: Using NovaFind

NovaFind is a utility designed to discover *NovaRoams* on a network. After a *NovaRoam* has been located, you can obtain or change a *NovaRoam's* IP address or Netmask.

NovaFind does not require installation. Simply locate the NovaFind folder on the *NovaRoam* CD. Copy the file named NovaFind.exe to your local hard drive. NovaFind can also be run directly from the *NovaRoam* CD.

To Start NovaFind, double-click on NovaFind.exe. The NovaFind dialog box is displayed.

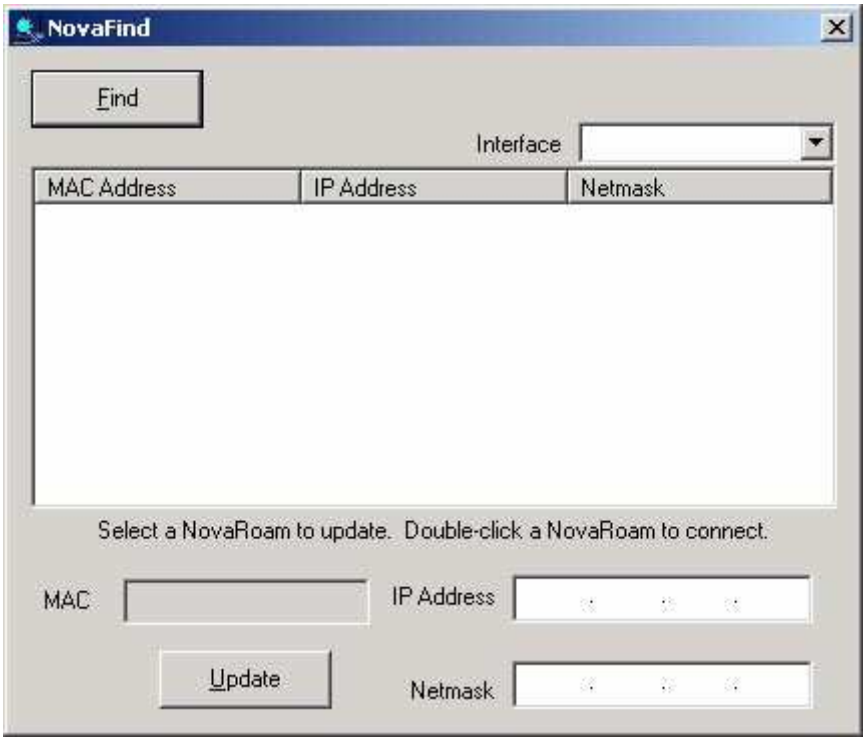


Figure 70: NovaFind Dialog Box

After launching NovaFind, specify the Network Interface that will used to find NovaRoams by selecting its IP address from the Interface drop-down menu. If you only have one Network card, it will be selected by default.

Click on the Find button. Any *NovaRoams* on the wired network will be displayed. *NovaRoams* will be listed by MAC address, current IP address, and Netmask. To select a *NovaRoam* from the list, click on the *NovaRoam* in the MAC address column. After selecting a *NovaRoam* from the list, the IP address or Netmask can be changed. Once selected, change the current IP address or Netmask to the desired address or Netmask in the appropriate fields. Clicking on the Update button commits the changes to the *NovaRoam*. After you click on the Update button, the NovaRoam reboots. Click on the Close button to close NovaFind.

After selecting a NovaRoam from the list, you can double-click the MAC address to connect to the NovaRoam's configuration software.

Note: In order to connect to a *NovaRoam*, the *NovaRoam* and computer must have IP addresses that are from the same network. If you use NovaFind to change the IP address of a *NovaRoam*, you still will not be able to connect if both the *NovaRoam* and computer are not on the same network.

Note: NovaFind may not work on computers with more than one network interface card. NovaFind can be made to work in this situation by temporarily disabling the network card that is not connected to the *NovaRoam.*

Appendix D: Antenna/Cable Requirements

The *NovaRoam EH900* must be installed by a professional in order to comply with FCC Part 15 radiated power limits. Furthermore, only antennas supplied by Nova Engineering may be used with the *NovaRoam EH900*.

The FCC mandates that the Effective Radiated Power (ERP) may not exceed +36 dBm. This is equivalent to a *NovaRoam EH900* running at full output power (1 watt/+30 dBm) with a +6 dBi antenna. The antenna cable must have sufficient loss to push the ERP to below +36 dBm if a higher gain antenna is used. For example, using a +8 dBi antenna with the *NovaRoam* at full power would result in an ERP of +38 dBm. In this situation, the antenna cable must provide at least 2 dB of loss in order to bring the ERP into compliance.

The *NovaRoam EH900* also features the ability to decrease the transmit power. Any decrease in output power should be considered when calculating ERP.

Table 4 describes the amount of loss incurred by several common types of antenna cable.

Table 4: Antenna Cable Loss

Type of Antenna Cable	Loss per 100' of cable
LMR-400	3.9 dB
LMR-600	2.5 dB
LMR-900	1.7 dB

Table 5: Antenna/Cable Loss Examples with LMR-400 Cable

Antenna Gain	Cable Type/length/loss	ERP
+8.2 dBi	60’ LMR-400, 2.3 dB loss	+35.9 dBm
+10.2 dBi	110’ LMR-400, 4.3 dB loss	+35.9 dBm
+11.2 dBi	135’ LMR-400, 5.3 dB loss	+35.9 dBm

Note: Table 5 assumes 1 watt output power from *NovaRoam*.

Table 6: Antenna/Cable Loss Examples with LMR-600 Cable

Antenna Gain	Cable Type/length/loss	ERP
+8.2 dBi	90’ LMR-600, 2.3 dB loss	+36.0 dBm
+10.2 dBi	170’ LMR-600, 4.3 dB loss	+36.0 dBm
+11.2 dBi	210’ LMR-600, 5.3 dB loss	+36.0 dBm

Note: Table 6 assumes 1 watt output power from *NovaRoam*.

Table 7: Antenna/Cable Loss Examples with LMR-900 Cable

Antenna Gain	Cable Type/length/loss	ERP
+8.2 dBi	135’ LMR-900, 2.3 dB loss	+35.9 dBm

Antenna Gain	Cable Type/length/loss	ERP
+10.2 dBi	250’ LMR-900, 4.3 dB loss	+36.0 dBm
+11.2 dBi	310’ LMR-900, 5.3 dB loss	+35.9 dBm

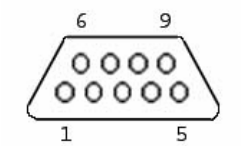
Note: Table 7 assumes 1 watt output power from *NovaRoam*.

If you are using alternate cable types, always verify the cable loss prior to installation.

Appendix E: Interface Pinouts

The RS-232 Interface of the NovaRoam EH900 is configured as Data Communications Equipment (DCE).

***NovaRoam* RS-232 Interface Pinout**



Pin	Function	Description
1	NC	No Connection
2	TXD	RS-232 Transmit
3	RXD	RS-232 Receive
4	NC	No Connection
5	GND	Signal Ground
6	NC	No Connection
7	CTS	Clear to Send
8	RTS	Request to Send
9	NC	No Connection

NovaRoam Ethernet Interface
Pinout (RJ-45)

Pin	Function	Description
1	TXD+	Transmit
2	TXD-	Transmit
3	RXD+	Receive
4	NC	No Connection
5	NC	No Connection
6	RXD-	Receive
7	NC	No Connection
8	NC	No Connection

Warranty Information

Limited Warranty, Disclaimer, Limitation of Liability

For a period of one (1) year from the date of purchase by the retail customer, Nova Engineering warrants the *NovaRoam EH900* against defects in materials and workmanship. Nova Engineering will not honor this warranty if there has been any attempt to tamper with, modify, or repair the unit. This warranty does not cover and Nova Engineering will not be liable for any damage or failure caused by misuse, abuse, acts of God, accidents, or other causes beyond Nova Engineering's control, or claim by other than the original purchaser. If, after inspection, Nova Engineering determines there is a defect, Nova Engineering will repair or replace the *NovaRoam* at no cost to you. To return defective merchandise to Nova Engineering please call Technical Support 1-513-642-3020 to obtain a Return Merchandise Authorization (RMA) Number.

In no event shall Nova Engineering, Incorporated be responsible or liable for any damages arising:

- From the use of the product
- From the loss of use, revenue or profit of the product
- Because of any event, circumstance, action, or abuse beyond the control of Nova Engineering

Whether such damages be direct, indirect, consequential, special or otherwise and whether such damages are incurred by the person to whom this warranty extends or a third party.

Warranty Return Policy

If you have difficulty with your *NovaRoam* product, please call Nova Engineering Technical Support at 1-513-642-3020. Nova Engineering Technical Support will assist with resolving any technical difficulties you may have with your product. If after calling Nova Engineering Technical Support it is determined that your product is defective, you may return the product to Nova Engineering after obtaining an RMA (Return Materials Authorization) number. The product must be returned in its original packaging. The RMA number should be clearly marked on the outside of the box. Nova Engineering will not be held responsible for any product returned without an RMA number. No product will be accepted without an RMA number.

CAUTION

Changes or modifications to the *NovaRoam EH900* not expressly approved by Nova Engineering could void your authority to operate this equipment.

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